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Manganese Resources of the Northwest

AND

What Is Being Done to Use Them

By John H. Cole

President, Domestic Manganese and Development Co.

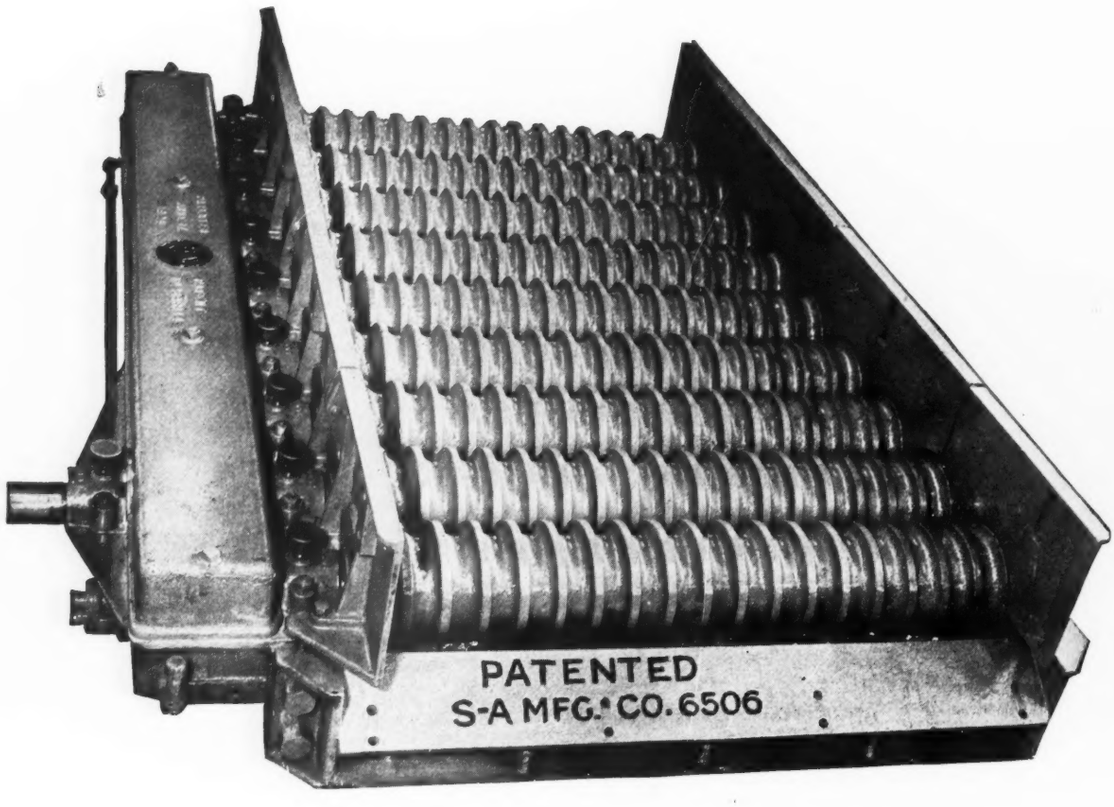
A reason why an adequate tariff should be maintained on manganese

Also

Square-Setting in the Butte District, by Clarence M. Harrer

Floating a Gold Ore in Cyanide Solution, by J. M. Tippett

Ore Deposits of Chile-II, by James E. Harding



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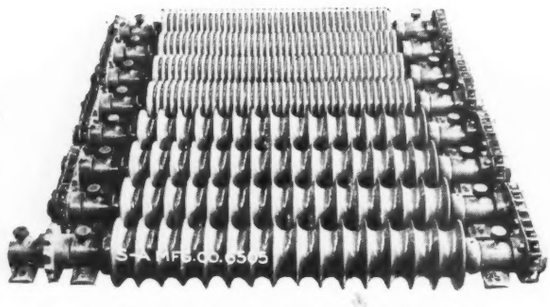

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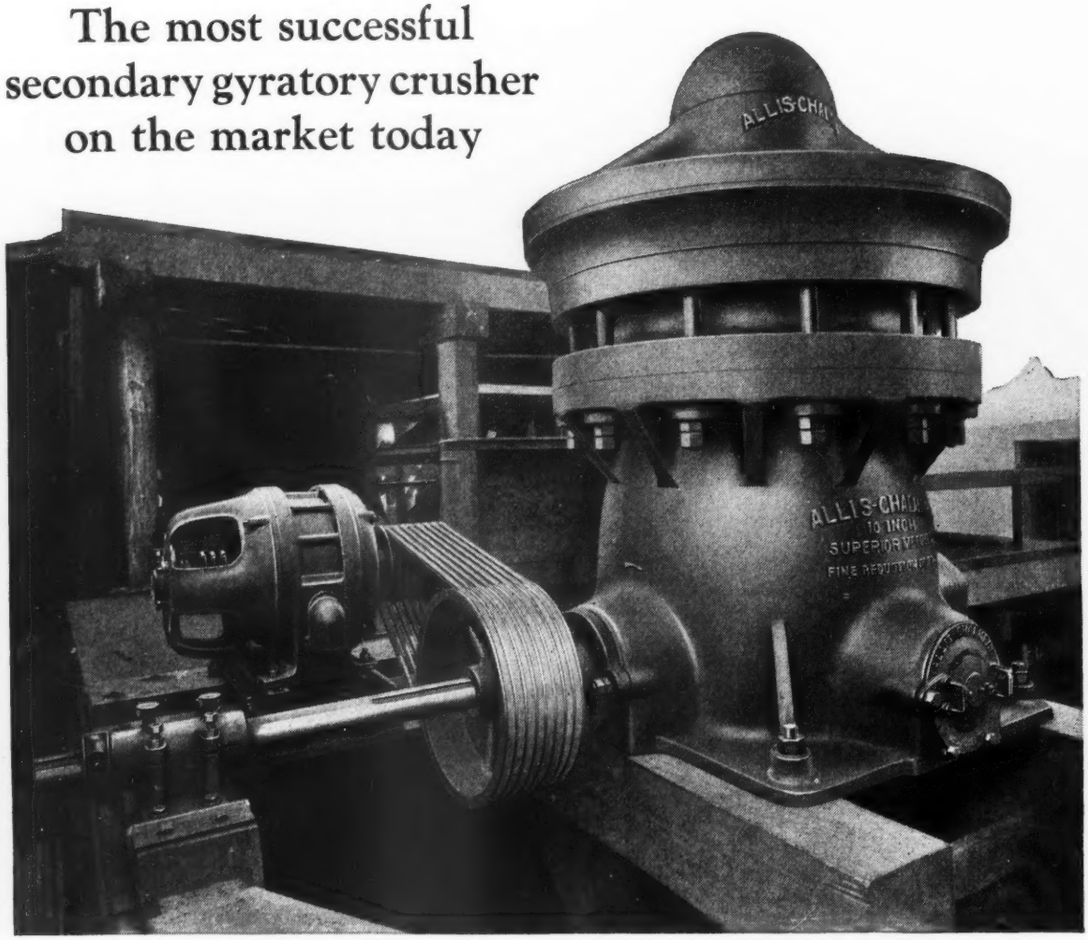

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		¾	⅞	1	1¼	1½	1¾	2	2¼	2½	3	3½	4	Size in Inches	R.P.M.		
6	6x40	24	28	32	40	48								36x12½	500	40 50	32,000
10	10x52					80	94	107	120	135				36x19	450	75 100	64,000
18	18x68									250	300	350	400	44x25	400	150 200	182,000

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ENGINEERING AND
MINING JOURNAL

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The Manganese Situation Clearer

THREE MONTHS HAVE PASSED since the question of the manganese supply of the United States in relation to war preparedness was discussed at Cleveland. Those present at that meeting were told that the nation's manganese resources were negligible; that the country's needs were met largely by imported manganese; that sudden war might cut these imports off; and that, in fine, something must be done, inasmuch as manganese was indispensable for making war. What should that something be?

In the light of the knowledge gained about domestic manganese in the last three months, it appears most strange that the prominent speakers of the meeting proposed, as the proper course to be pursued, that the tariff on manganese be removed. This, they said, would keep the domestic reserve untouched and in the ground against possible war emergency. In this they were simply following, rather blindly, to put it charitably, the formula that a protective tariff tends to promote the early exhaustion of a limited reserve of an essential mineral.

They were wrong, however. The formula itself, though quite correct, is vague as to its meaning unless definite values be given the terms "limited" and "early." How limited is the reserve of domestic manganese? In ores and materials of various grades in the United States it is much greater than the bland assertions of these opponents of the tariff would indicate. These opponents have preferred to stress the unchallenged fact that the country has a very small reserve of ores of the grade sought at the moment by manufacturers of ferromanganese. They have preferred to keep silent or say but little about the possibilities of beneficiating the lower-grade materials and of thereby securing a product that ferro makers might utilize. It is in such beneficiation that the hope of developing a domestic manganese industry lies.

How much hope is there of doing this? The description on another page of the project now on foot to treat the manganese carbonate ores of Butte and elsewhere indicates that there is considerable hope. Given the incentive of a possible decent profit, there is strong likelihood that in the Pacific Northwest alone a stable domestic manganese industry can be developed—one on which the steel producers and the government can depend in case of war. But those who have ventured on this project must inevitably become discouraged if the tariff on manganese is removed. Indeed, it cannot be too strongly urged that the infant domestic industry of today and its chances for the future will be destroyed if the tariff is taken off.

If the opponents of the tariff still declare that in this way the manganese deposits would be conserved in the ground against possible future war, let it be remembered that, were war declared, a domestic manganese industry could no more be developed overnight than a million men could be made to spring to arms. As a measure of preparedness, then, the development of a domestic industry, if it be possible at all, should be encouraged in every feasible way.

Accumulation by the government in time of peace of a stock of manganese ore to insure the nation against a failure of its steel supply in case of war has been suggested. Much wisdom lies in this proposal. At once it opens to the government a way of encouraging the development of a domestic industry in addition to that of protecting it with a tariff. Let the government buy the domestic producers' output and store it until it has sufficient ore to satisfy its requirements for preparedness. Any legislation to make possible such purchases should provide that domestic ore be bought. Funds for the purpose would be furnished by the tariff. No war looms at present, nor seems likely for several years to come. The opportunity is therefore good for carrying such a program to completion. This proposal should satisfy all except producers of foreign manganese ores, who naturally would like to sell some portion of their output to the government at Washington.

The agitation to remove the tariff began openly at Cleveland. Ostensibly that meeting was a joint gathering of two national societies in the interest of preparedness. Actually, it was a meeting at which steel men predominated and where domestic manganese producers were sparsely represented. Those producers who did appear were naturally reluctant to state their desire for a continuance of the tariff for fear of offending the steel companies who buy their product.

Furthermore, at the sessions of the meeting the principal advocate of the removal of the tariff, with its consequent lowering of the bars to foreign ores, was a distinguished gentleman who only recently had returned from visiting the properties of the Harriman manganese concession in the Caucasus. The connection is obvious, and it is hoped that the Tariff Commission will properly appraise it.

That the steel interests should seek to have manganese put on the free list is not surprising. So long as they get their manganese, they care little where it comes from. But those of them whose memory goes back to the anxious days of the war, when at times it seemed doubtful that the needed supplies of manganese could be obtained from abroad, must in their hearts wish never to see those days return. They should then bend their efforts to fostering the development of a domestic manganese industry instead of seeking to destroy that which now exists. The tariff that they pay is for them a trifle, and in any case is passed along to the ultimate consumer of their products—the public. No adequate explanation of their attitude appears, unless it be that they have been misinformed as to the manganese resources of the country and as to the research work that is in progress. Or do they seek to acquire for a fraction of their worth the domestic manganese properties that might be offered them were the domestic industry destroyed through the removal of the tariff?

When Better Quotations Are Made, *E.&M.J.* Will Make Them!

A RECENT ISSUE of one of the daily metal-trade papers published in New York contains an advertisement in which the following is printed over the signature of Clarence B. White, a metal smelter and dealer in Philadelphia:

"If the copper producers realize 12.70 refinery for their export copper and 12.425 refinery for Connecticut Valley shipments how can the *Engineering & Mining Journal-Press* justify a quotation of 12.225?

"Taking into consideration the fact that foreign and domestic shipments are about equal, our idea of an accurate quotation would be 12.56.

"We know we will be panned for thus treading on delicate ground but we cannot help but express the opinion that we believe is in the minds of many in the trade."

The disarming—one might almost say apologetic—tone of the statement, together with the fact that certain points are involved that are not clearly understood in the trade, prompts us to publish an answer. Mr. White is perhaps more polite than he is accurate, for we challenge him to show a day when copper was selling at 12.50c., Connecticut—which would be equivalent to his 12.425c. refinery, if the r.i.t. (refining in transit) rate were applied—on which the *Engineering and Mining Journal* published a quotation of 12.225c. However, this slip merely exaggerates the apparent spread between the quotation as published by us and the one that Mr. White thinks is "accurate." It does not remove the two points wherein misunderstanding arises. These may be summarized as follows:

First: the matter of the logical amount to deduct from the delivered price in Connecticut to obtain the refinery price. If from the "through" freight rate from the Western smelter to the plant of the consumer in Connecticut the rate from the smelter to the refinery is deducted, the difference is approximately 7½c. per hundred pounds, or 7½ points. If this figure be subtracted from the delivered price, the result will be higher than that obtained by subtracting 22½ points, the figure that we have determined, by compiling complete data from all of the large sellers, to represent the average local freight rate from the various refineries to the various important Connecticut and other New England destinations. Not all copper delivered in this area enjoys the r.i.t. privilege, and such as does is intrinsically worth no more nor less than that which must pay the local freight, and with which it must compete. It seems more logical to view the r.i.t. saving as reducing the cost of shipping blister 2,000 miles, rather than the cost of shipping refined metal 200 miles. The enjoyment of the r.i.t. rate may be conceived as comparable to an advantage in lower operating costs in the refinery. On the face of things it may appear that the shipper of custom ore to a smelter would suffer as a consequence of this method of calculation. As a matter of fact he does not, because if we were to revise our method of determining the refinery price, the smelting companies would without doubt immediately change the basis of their contracts and settlement sheets.

Second: the matter of the price for foreign shipments as fixed by Copper Exporters, Inc. The best data obtainable show that the cost of marketing copper in foreign countries is close to ⅜c. per pound. This includes, in addition to handling, the ocean freight, insurance, and interest for considerably longer periods than apply to domestic sales, the extra expense that is involved in maintaining sales agencies in foreign countries. It is true that copper recently was quoted at 13c. c.i.f., which would be equivalent to 12.625c. refinery, at a time when 12.50c. was being done in Connecticut. At the same time it should be pointed out that this price was almost nominal and that little business was done at that time. On the other hand, since then, foreign buying has been active at a time when domestic prices have been much higher. The price of 12.875c. in Connecticut was close to parity with 13c. in the foreign market; in fact, it may be considered as being somewhat higher than parity. Copper Exporters repeatedly has expressed the intention of keeping the foreign price in as close step with the domestic market as practicable, as the two markets have been in years past. Unless the association should adopt a policy of continually maintaining the foreign price at levels well above domestic parity, it is evident that no new element will be introduced into the determination of copper quotations.

In any event it may be pointed out that the explanation printed in small type under the table of daily prices published each week in the *E.&M.J.* market section says expressly "prices . . . for domestic consumption," which forms by long odds the major market for producers whose smelter contracts are based on *E.&M.J.* quotations. Whatever may happen abroad, we are doing accurately what we profess to be doing.

In conclusion, Mr. White may rest assured that this is not "delicate ground" with us. We make no secret of what we do, nor of how we do it. We welcome any suggestion that will improve the method or the result.

Light and Darkness

DIRECTORS of some mining companies, particularly in Europe, seem as firmly convinced as ever that the policy of operating their plants behind locked doors, so far as visitors are concerned, is to their interest. They advance the same old argument that intense competition forces them to refrain from allowing their pet little improvements to become public. This practice reminds us of the reply made by a would-be policeman at a recent civil service examination in New York. The question was asked: "If a man buys an article for $12.25 and sells it for $9.75, does he gain or lose on the transaction?" The answer was, "He gains on the cents but loses on the dollars." This, one fancies, is the way the managers of most secret mining and metallurgical plants gain.

At most mining plants in the United States, and in the Americas generally, visitors with technical education and experience are welcome. They are not only shown through the plant, but they are shown through by a responsible official, conversant with the work, and, as likely as not, even details of costs are freely presented. The time and effort so used is not considered a matter of charity. The host knows that he may have the same privileges at his guest's plant. It may very well be, also, that he learns more from the visitor than the visitor learns from him. Thus has mining and metallurgical practice advanced by leaps and bounds in this country.

Competition, though, is sometimes very real. In Utah, for instance, there is certainly competition between two large custom mills practicing selective flotation. Yet, both of these plants are open to properly accredited visitors, and, owing to their modern equipment and practice, are very popular mills to see. Each depends to a considerable extent on good management and service to

compete with others, rather than on a secret process—or processes that are *thought* to be secret.

The only really good general reason why a plant manager should refuse to show a visiting engineer through his works is that his visitor comes from a company that is unwilling to reciprocate. Mules that have worked underground for long periods should not be suddenly taken into the light.

Metal Prices Improve

THE INCREASE in metal prices during the last week or so comes at a time when "midsummer dullness" in business might well have been offered as an excuse for a lifeless metal market. Hot and humid though it was when the buying movement was getting its initial momentum, it becomes evident that a reasonable amount of purchasing could no longer be delayed, and sellers were quick to advance prices to more profitable levels after they had been scraping bottom for several weeks. It is distinctly encouraging to note that the strength has not been in the metals alone, else it might have been considered merely a passing breeze that would quickly subside. Other commodities have also advanced, as is indicated by Irving Fisher's weekly index, which rose from 138.8 in the week ended July 1 to 140.5 in the week that ended July 15. The index of the Harvard Economic Service also showed a sharp increase beginning with the week ending July 13. The stock market, too, has been buoyant, a good omen for the future.

Without doubt, general business conditions during the first half year have been below the level of the first half of 1926. But an excellent fall and winter trade is confidently expected, and current increases in prices of metals and other raw materials seem to be well justified by the business that manufacturers expect to do two or three months hence. As long as money remains easy no very serious industrial slump is at all likely to eventuate.

It is to be hoped that producers will not expand output as a result of higher prices. Overproduction has been a spectre too long. It is more a ghost than a reality, but it has been a very healthy ghost and has been too much of a power in keeping down prices. By holding production in check, even with better prices, perhaps the ghost may be laid low.

The Shifting Mining Scene in California

CALIFORNIA has been, is now, and will continue to be a great mining state. Second only to its salubrious climate, and ranking ahead of its movie lots, oranges, and tennis champions, California's fame in the popular mind rests on its gold mines. Since the days of the Argonauts of '49, California usually has led the states of the Union in the production of gold. For brief periods Colorado and Alaska each exceeded it, but in most of the last seventy-five years California has easily outranked the others, and its aggregate production is greater than that of all the other states put together. Likewise, the state has been a producer of silver and copper in important quantities. To some it may be rather disconcerting, therefore, to read in the latest summary of the Bureau of Mines that the value of the output of each of these metals declined in 1926; that the total value of all metals decreased by 15 per cent; and that the entire production was worth only $20,050,801. Dredging accounts for nearly half of the gold produced, and a considerable drop from this source is assured in the next few years, so that as a producer of metals the importance of California appears to be waning.

Just now it is third among the states as a producer of mineral wealth by virtue of its petroleum output, valued in 1926 at $355,000,000. Incidentally, Pennsylvania, with its coal mines, is first, and Oklahoma, another oil state, is second. But it is not petroleum alone that contributes to the "mine" production of California. Nonmetallic minerals, dug in the orthodox way, are constantly increasing in importance. In 1926 there was produced cement to the value of $27,000,000 (well in excess of the gross value of metals); crushed rock and gravel worth $17,500,000; brick and hollow tile, $7,500,000; potash and borates, $4,300,000; and magnesite, $543,000. The state contains minerals of great variety, and with new consuming interests being established every year, exploitation of these resources will expand rapidly.

The course of events in California in many respects is typical of that in other parts of the country. No one can say with assurance that new and important metal mines may not even yet be opened in the state of the Golden Gate, but in any event the mining industry—the winning of metal and non-metallic minerals from the earth—is greater than ever before; and it will continue to grow.

The Rockefeller Foundation

THE DEBT OF THE MINING INDUSTRY to the Rockefeller Foundation would be difficult to appraise. If only the work done by the Foundation in fighting yellow fever in the tropics were considered, how much this has meant to the traveling mining engineer would readily be appreciated. Mining is an industry that is international in scope, and the call of the prospect to be examined or developed may take the engineer anywhere on earth. Once, the risk of fever and disease to be encountered was enormous. Today, though still considerable, it is decidedly less in many places. The natural growth of knowledge of medicine, hygiene, and sanitation in the countries of the tropics has contributed to this end; but the Foundation through its work has played an important though often inconspicuous part. It is, with the exception of the Red Cross, perhaps the only organization that has the physical welfare of the world at heart without respect to national boundaries.

How widespread the Foundation's work has been is set forth in its report for 1926. In that year it aided the growth of fourteen medical schools in ten different countries, helped twenty-one governments combat hookworm disease, and shared in the creation or support of various departments in state or national health services in sixteen foreign lands; it co-operated with Brazil in the control of yellow fever and continued surveys and studies of this scourge in Nigeria and on the Gold Coast, and assisted the development of professional public health training in fifteen institutions abroad and in ten field stations in the United States and Europe. These are but a few of the twenty distinct accomplishments that are recounted in its annual report. A great work this is—a greater work than the building of the petroleum enterprise from which sprang the funds that finance it.

H. A. Pumpelly

Significant Developments in American Manganese

By H. A. Pumpelly
Vice-President, Domestic Manganese & Development Co.

THE available information on the subject of manganese and manganese reserves in this country is so negative that the impression prevails at the present time in the minds of the interested public, and even in the minds of the high officials of our government, that we are without any manganese ore in the United States.

In a sincere effort to contribute definite and accurate information on the subject of our national manganese reserves, it is a privilege to present briefly to those individuals who, for patriotic reasons, are unselfishly seeking the truth, a very fundamental and significant development that is taking place in our own Northwest.

IN FAIRNESS to the noted geologists who have been working at intervals for years on a survey of the manganese resources of the country, it should be said that the surface indications thus far recorded are not as convincing as those in other countries. Surface indications, however, do not prove the possible ore reserves beneath, as has been repeatedly demonstrated in many a mining camp. It is a matter of mining history that one of the great copper men of Montana's early days was thoroughly satisfied when he succeeded in selling his vast interests to what is now one of the largest mining organizations in the world, believing, as he did, that the end of his ore reserves was in sight. Subsequent development of the same properties at deeper levels has proved the existence of richer and greater ore reserves than those that he himself ever possessed.

AS IT HAS BEEN WITH COPPER in these properties in Montana, so it is with manganese. For years the existence in them of large deposits of rhodochrosite ores has been well known. The impression has been created by certain geologists, however, that this manganese could not be won save as a byproduct in the mining of zinc and other ores, for which the properties at the moment were primarily being worked. No greater misstatement of fact could possibly be made. In the most conspicuous of the properties in which this manganese ore occurs, a very large tonnage of rhodochrosite has been developed which will be mined even though it were necessary to discontinue the extraction of zinc ore completely. And now that a market for rhodochrosite ore is in the making, at least seven substantial and developed deposits have already been brought to the attention of my associates and myself. A huge tonnage of these ores is actually in sight today.

FURTHERMORE, and of vital importance, the problem of the metallurgical treatment necessary to make this rhodochrosite ore merchantable for steel-manufacturing purposes has been completely and successfully solved. Thus a way has been opened to the attainment of at least a limited and, very possibly, in due time, a complete independence of foreign manganese supplies. This development bears out the statement made some time ago by Mr. J. V. W. Reynders that "limited independence of foreign supplies might be obtained, provided a solution was found for the metallurgical problems involved in the treatment of the Montana rhodonite and rhodochrosite."

DEVELOPMENT of a stable domestic manganese industry in this country calls for capital, organization, protection and adequate metallurgical skill. These fundamentals have been provided. The ore reserves are assured. There is not the slightest doubt that the U. S. Tariff Commission, when it finally becomes aware of the facts of the situation, knowing as it does the country's vital need of independence with respect to its manganese ore supply, will continue to foster the domestic industry that is now assured, by protecting it with an adequate tariff.

Manganese Resources of the Northwest and What Is Being Done to Use Them

By John H. Cole
President, Domestic Manganese & Development Co.

John H. Cole

BECAUSE of the impending hearing of the United States Tariff Commission on manganese, lively attention has recently been directed to the manganese resources of the United States and the potential development of this adolescent industry under the protecting ægis of the now threatened import duty on foreign ores.

It was just ten years ago, in 1917, that production in the Butte and Philipsburg districts suddenly jumped so far ahead of the other states as to put Montana in the lead as a producer of manganese ore. Prior to 1916, no manganese is known to have been mined in Montana, other than a small shipment reported in 1900. Yet during 1917 and 1918 two-thirds of the total domestic production was supplied by the Treasure State, most of this production being smelted to ferromanganese for use in the making of steel. The ore produced by Montana in these two years, at the rate of 3 tons of ore to 1 ton of alloy, would have yielded 87,000 tons of alloy, an amount sufficient to manufacture 15,000,000 tons of steel, or about one-sixth of the total amount made in the United States during these two years. In 1919 Montana's manganese production equaled nearly one-half, and in 1925 it was 77 per cent of the manganese output of the entire country.

Immediate and active stimulation of manganese ore mining and treatment in Montana and the entire Northwest is foreshadowed by the organization in Chicago in April of this year of the Domestic Manganese & Development Co., of which H. A. Pumpelly, of New York, is vice-president; R. J. Jones, of Chicago, treasurer; T. D. Clark, of Youngstown, Ohio, vice-president; Frank T. Boyd, of New York, director; Cathryn L. Cole, secretary, and myself president. The capital stock of $250,000 has all been subscribed and paid for.

The original purpose of the company was the development of manganese orebodies in Montana. However, the company has received numerous requests to examine manganese orebodies located in Arizona, California, Washington, Colorado, Idaho, Missouri, and Virginia.

That there are extensive deposits of manganese in the Northwest is thoroughly substantiated by the comprehensive surveys made in Montana, Utah, Oregon, and Washington by J. T. Pardee and described at length in his 100-page article in Bulletin 725 of the U. S. Geological Survey. Supporting testimony is adduced in articles by D. F. Hewett and E. C. Harder, in Bulletin 666.

In the Butte district, the zonal arrangement of minerals is well defined. In the central zone copper minerals predominate and there is no manganese. In the intermediate zone surrounding the copper area the zinc minerals appear and the copper becomes less. The manganese silicate, rhodonite, and the carbonate, rhodochrosite, begin to appear in small quantities, increasing perceptibly toward the outer limits. In the outer zone there is an abundance of rhodonite and rhodochrosite with much sphalerite, but the zinc becomes less toward the outer edge, leaving the veins composed chiefly of quartz and manganese. In the outer part of the intermediate zone and the inner part of the outside zone the manganese minerals occur in small veinlets and in bands and streaks in the larger veins. In mining the zinc ores some of this manganese material is necessarily broken. Such manganese occurrences are not regarded as ore.

In the outer zone, however, there are very large masses of pure rhodochrosite, especially in the big vein which goes through the Emma, Czarromah, and Travona mines. In these properties rhodochrosite has been the object of extensive mining operations. It occurs pure and free from zinc. Stopes have been excavated from 5 to 15 ft. in width, one stope in fact attaining a width of 40 ft. Such deposits are not to be confused with the scattered occurrences of manganese in the intermediate zone. In these properties zinc ore is mined independently of the manganese. It is usually sphalerite, free from rhodochrosite, but where associated with rhodochrosite the latter is easily sorted out. In the manganese stopes no sorting is necessary.

Other occurrences of manganese in the Butte district are the oxidized outcrops of manganese-bearing veins. A number of these are capable of supplying pyrolusite from surface operations. Of course, many oxidized outcrops contain the oxidized manganese minerals in too small a quantity to be regarded as ore. Such occurrences correspond to the manganese content in the intermediate zone.

Much of the silver ore shipped from the leasing operations in the intermediate zone contains rhodonite and small amounts of rhodochrosite as gangue. Such ores are essentially silver ores. Substantial shipments, however, have been made in which oxidized manganese was the principal element and was paid for under the manganese contract, with allowances made for the silver contained in the ore.

It is therefore a fact that some manganese in Butte is an accessory to other mining operations in the intermediate zone, but that important masses of commercial manganese in the form of rhodochrosite and smaller occurrences of pyrolusite exist and are minable for manganese.

Furthermore, as Pardee states in Bulletin 725, "The Butte manganese deposits possess the advantages of being large and economically mined. Most of them can be developed and the ore removed without additions to the workings needed to exploit the ore of other metals. With abundant facilities available for concentrating the ore and making ferro-alloys, the operators

are in a position to take advantage of any favorable market without delay."

More recently—in fact within the last eighteen months—important manganese deposits have been located in Idaho. These being relatively near and easily accessible, time was taken to investigate the Ames mine, in that state, where 20,000 tons of ore, averaging 46 per cent manganese, was found. Outcroppings of manganese on the surface were traced for a distance of 45 miles, and at the one place where development work had been undertaken, the above-noted tonnage was disclosed. Over the entire area, these outcrops are uniformly strong and well defined, and it is reasonable to believe that the one place opened is typical of the rest.

If the present tariff on foreign manganese is retained, it is the purpose of our company thoroughly to prospect this Idaho region, on which we now hold a lease and bond. Should the undeveloped area develop the quantity and quality indicated by the 20,000 tons already mined, Idaho alone should be able to produce enough manganese ore to supply the needs of this country for years.

Our company has also under lease several large bodies of manganese ore situated in the Philipsburg district—65 miles from Butte, where our reduction plant is located. The undisputed quality of the Philipsburg pyrolusite is known all over the world. In addition to this oxidized manganese ore, hundreds of thousands of tons of carbonate ore, or rhodochrosite, are minable from the old Granite Mountain mine, the Algonquin, and the Trout mines. Also, at Three Forks, 74 miles from Butte, a large mass of rhodochrosite has been developed, and at Cataract Gulch, near Basin, 30 miles from Butte, another immense body of this ore has been located.

In Butte itself this "pink ore," or rhodochrosite, is so readily available and occurs in such large quantities as to have resulted in the execution of contracts whereby our company has agreed to purchase from the Anaconda Copper Mining Co. and the W. A. Clark interests 750,000 tons within the next five years. That alone means 150,000 tons a year, or nearly 25 per cent of all the ore imported into the United States during 1926. In addition, contracts are also being negotiated for thousands of tons from the other deposits previously mentioned.

Ore Treatment Problems Solved

In his paper arguing for the removal of the tariff on manganese and read at Cleveland last April, John V. W. Reynders made this significant statement:

"Limited independence of foreign supplies might be attained provided a solution were found for the metallurgical problems involved in the treatment of the Montana rhodonite and rhodochrosite."

In reply to the above, I am happy to state that the problem of reducing the Montana rhodonite and rhodochrosite has been solved by a simple and economical process of electrical separation, which our company will initiate immediately on completion of our plant. In this electro-magnetic operation, the manganese content is raised from 37 to 45 per cent, after which the nodulizing process raises it still further to 66 per cent.

As to the treatment of the Butte rhodochrosite, I am indebted to the Research Department of the Anaconda company for the following brief description of the nodulizing of manganese carbonate ores, a process which that company successfully worked out some months ago:

"In the latter part of 1926 experimental work was instituted by the research department in Anaconda to find some method which would change both the chemical and physical nature of the manganese carbonate ores from the Butte district in order to obtain a product more acceptable to the trade. This first work was done in an oil-fired rotary kiln of small capacity and was carried to such a stage as to warrant further development on a commercial scale.

"The larger-scale operations were carried out in one of the kilns of a Montana cement plant which at the time this work was done was not in operation. The kiln used was 140 ft. long by 9½ ft. diameter at the front, bottle shaped, necking to 8½ ft. in diameter. The product discharged from the kiln was conveyed to a rotary cooler, the discharge of which was loaded directly to cars for shipment. Pulverized coal was used for firing the kiln. This plant, designed for the manufacture of cement, was not efficient mechanically for handling manganese ore. In a plant designed for this purpose much greater efficiency could be obtained.

"A brief description will suffice to give a general idea of the operation. The rhodochrosite ore crushed to approximately 2½ in. for sampling was fed directly to the kiln. The direction of flow of the ore was toward the firing end of the kiln. The calcining of the ore—driving off the CO_2—began at an early stage of its passage through the kiln, the coarser particles of ore breaking down during this stage of the operation. The calcined ore entering the sintering zone was brought to a temperature just sufficient for incipient fusion. When this condition was reached the ore particles would agglomerate. The size of the product as discharged from the kiln was very readily controllable. The bulk of the product obtained was from ¼ in. to ¾ in. in size and the percentage of fine material very small.

"A total of over 4,000 tons of the finished product was obtained from this operation of nodulizing the carbonate ores. The original ore assayed 37 per cent manganese. The nodulized product obtained assayed 56.5 per cent manganese. Physically, an ideal product for subsequent smelting was obtained. The nodules were of a reasonably uniform size, hard, but somewhat porous—and the percentage of fines very small.

"In this operation, the first of its kind in the West, surprisingly few operating difficulties were encountered. The difficulties which were not entirely overcome in the original work will be eliminated in a properly designed plant which will reduce operation to a simple process."

The Domestic Manganese & Development Co. has leased the site and building of the Butte Reduction Works from the Anaconda company and has placed orders for machinery with the Allis-Chalmers company, which also designed this plant exclusively for the treatment of manganese ores. Operations will begin Sept. 1.

This $400,000 mill will have an initial output of 300 tons per day of a finished product of the highest quality obtainable anywhere and which will help to free the steel manufacturers of the East from their dependence upon foreign ores.

If adequate protection is provided by the retention of the present tariff, this enterprise will also mean much to Butte, western Montana, and southeastern Idaho, by giving employment to several hundred workmen.

It is my understanding that the Tariff Commission has ordered an investigation of the manganese situation in the United States and that certain members of that body may soon visit this region. To them we extend a cordial invitation to visit our own holdings, as well as those of other producers located in this territory, confident in the belief that they will find a new and largely unsuspected source of new national wealth in the extensive manganese resources of the vast Northwest.

Square-Setting in the Butte District

By Clarence M. Harrer
Montana School of Mines, Butte, Mont.

Clarence M. Harrer

VEINS in the Butte district with few exceptions are opened up from vertical shafts. Shafts are usually in firm country rock, although in some instances the plane of the vein is intersected. Shaft stations vary greatly in size, shape, and method of timbering. In most mines they are large and roomy. Crosscuts are extended from stations to intersect the vein on the shortest distance. The sill, or lowest floor of a stope, is formed by drifting along the strike of the vein over its entire width from foot to hanging wall, or in other cases it is driven only one or two sets in width. When driven in ore, the sill is timbered with the standard "rocker" drift sets (Fig. 1) in the Anaconda Copper Mining Co.'s mines, and in other mines similar sets are now in use. In smaller mines miners frame their own timber and use their own initiative in timbering; in more important mines, the companies have a large central timber-framing plant, and smaller plants directly at the mine, for framing "specials." Levels in the various mines are driven in 100-ft. to 200-ft. lifts, although this may vary in different mines.

The sill crosscut to the vein is timbered according to the ground. It is generally in firm footwall rock and not subjected to subsidence resulting from stoping operations. In some cases where wet gouges, slips, or other bad spots are encountered, skin-to-skin timbering, or sometimes concrete, is placed. In fairly good ground the sill crosscut may be only partly timbered or not at all. It is generally double-tracked from the station for a sufficient distance to accommodate a full train of cars. From this point single track is used. After the crosscut has intersected the vein and drifting along the strike begins, the method of support conforms to the type of stope timbering to be used. This is illustrated in the figures that follow. In Butte mines, curves are almost always very sharp to "get around the timber." A more or less standard method of timbering curves in sill drifts is the rule. They are supported by using long (round or squared) caps (10 ft. 6 in.) approximately two sets wide, with posts at each end so as to avoid the motor and cars. Once the sill is well under way (along the strike) raises are started off to facilitate ventilation and as a means to transfer the ore, waste filling, and supplies between levels and stopes during subsequent stoping operations. The routine of driving raises was described in my article "Driving Timbered Raises at Butte," published on page 299 of *Engineering and Mining Journal* of Aug. 21, 1926.

Unconnected levels, especially in the deeper mines, are almost always hot and disagreeable to work in, unless somewhat cooled by the installation of blower fans with fan pipe carried along the timbers to the various working faces. The practice is to use flexible tubing or "rag pipe" rather than metal pipe, as the former is more readily handled, is more compact, and more flexible; this is especially advantageous when the pipe must be continually removed from the vicinity of blast or caves and again replaced. An efficient fan in a cool location, generally at the intersection of the crosscut and the orebody, will produce remarkable changes in the temperatures of working places. Metal tubing is often used in places where it is not in the way and

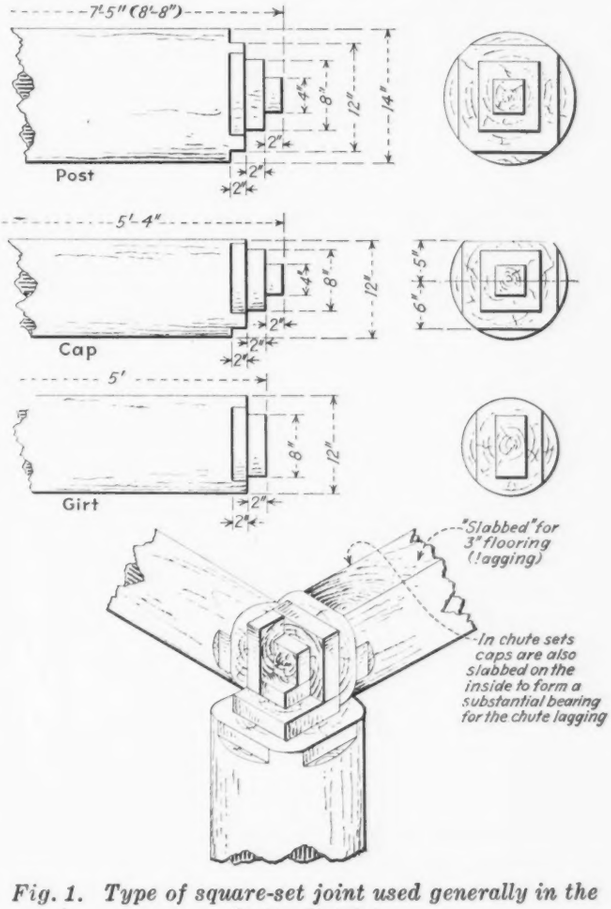


Fig. 1. Type of square-set joint used generally in the Butte district

Throughout the district, caps and girts are of standard dimensions, but the posts vary in length from 7 ft. 5 in. to 8 ft. 8 in. The Anaconda "rocker" step-down set has 7 ft. 5 in. posts, 5 ft. 4 in. caps, and 5 ft. girts. All posts shown in the accompanying sketches are assumed to be 7 ft. 5 in. long.

where the air is forced long distances by high-velocity fans, with or without booster fans, in one main artery, with supplementary canvas tubing splits.

In general, drifting along the strike of the vein and raising operations are so timed that several raises are "holed," or connected through, and others are started before actual stoping operations begin. In the spacing of raises, a number of points are taken into considera-

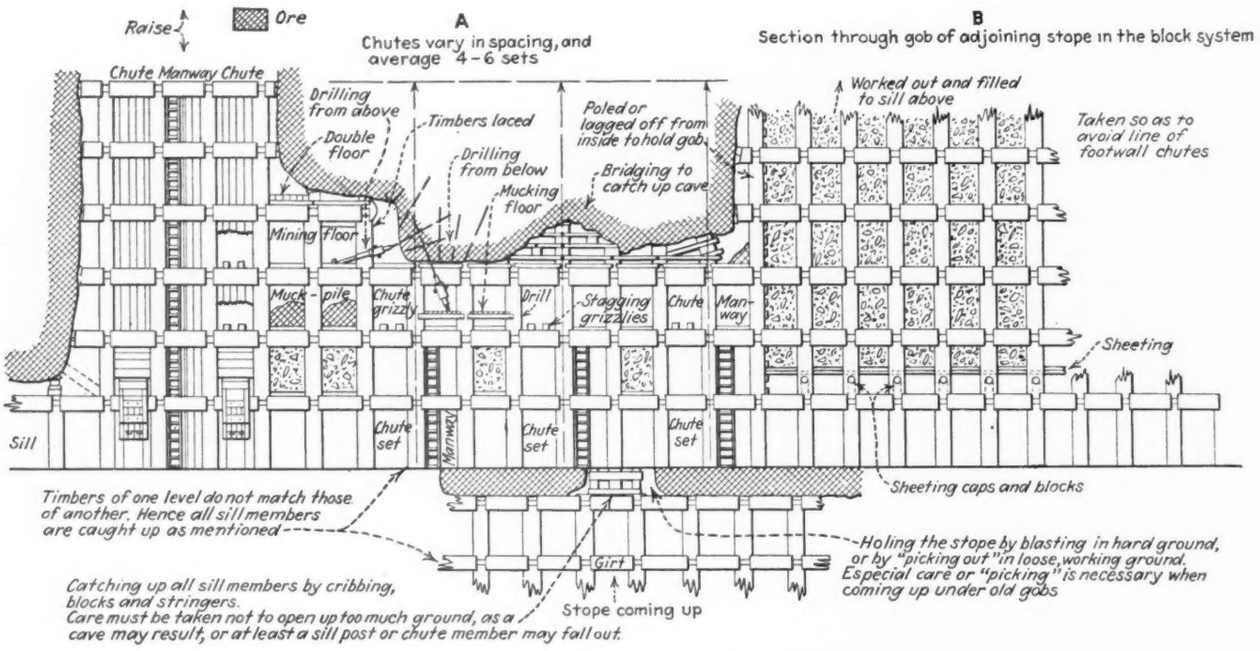

Raise
Ore
A
Chutes vary in spacing, and average 4-6 sets
B
Section through gob of adjoining stope in the block system
Chute Manway Chute
Drilling from above
Double floor
Timbers laced
Drilling from below
Mucking floor
Poled or lagged off from inside to hold gob
Bridging to catch up cave
Worked out and filled to sill above
Taken so as to avoid line of footwall chutes
Mining Floor
Muck-pile
Chute grizzly
Drill
Stagging grizzlies
Chute
Man-way
Sheeting
Sill
Chute set
Manway
Chute set
Chute set
Sheeting caps and blocks
Timbers of one level do not match those of another. Hence all sill members are caught up as mentioned
Holing the stope by blasting in hard ground, or by "picking out" in loose, working ground. Especial care or "picking" is necessary when coming up under old gobs
Girt
Catching up all sill members by cribbing, blocks and stringers. Care must be taken not to open up too much ground, as a cave may result, or at least a sill post or chute member may fall out.
Stope coming up

Fig. 2. Alternate stope and pillar method of stoping with square-set timbering. Longitudinal section is shown

tion—length of stope, distance between levels, speed of stoping operations, kind of stope, nature of the ground, use to which the raise is to be put, and convenience in the circulation of air currents. Examples of actual practice are as follows:

Case 1. A raise or stope interval was chosen at eight sets apart. A 6- or 8-post raise (two or three compartment) was driven at the ends of the stope blocks as shown in Fig. 2. In this case the ground was quite heavy and every alternate block was mined. This left a pillar of ore in the vein, which steadied the hanging wall and kept the timbers in the working stope from "diamonding," or getting excessively out of line. However, long before the alternate stopes were carried up to completion, the intermediate blocks or "pillars" showed signs of failure (cracking or sloughing). The ground began to work. The foot and hanging walls had comparatively thick fault gouges; in some instances these varied from moist to wet. This condition and the narrowness of the pillar blocks left a comparatively small bearing surface and may have been the cause of block movement. Later on, when mining out the intervening blocks, it was difficult to tie the pillar stope timbers to those of the gobbed (filled) stope, and because of the blocky nature of the ground, stoping became abnormally hazardous and much trouble was encountered from broken timbers and their replacement. In this case the pillar interval was probably too small. Hazards of mining were increased and work progressed much slower. Timber required considerable hand-framing and waste-filling had to be carefully kept up.

Case 2. Stopes were driven in series in which several working places were connected, thus forming long or continuous stopes. These stopes were not necessarily on the same mining level, but might differ by one or more floors. In this way, a whole segment of a level could be worked at once. The hazards and disadvantages of the alternate block system were eliminated and production was at a maximum. The raise intervals were increased. Ore passes and manways were carried up from the sill. A crew of timber or repair men could handle all timbering by being assigned to one block. This placed them on a separate timbering contract.

In the case under consideration it was found that at times large masses of the orebody broke loose and rode the timbers. This necessitated quite a bit of "bulldozing" and careful working; if the miners broke into the hanging wall a great deal of trouble would result from slabbing or sloughing. However, I found the system a great deal safer to work in than in some block systems.

Case 3. A vein was split by a waste lens; one stringer of ore ran along the hanging wall, the other along the footwall. There was enough waste in the horse for filling operations. Raises were driven at long intervals (fifteen sets, more or less, apart). Ore passes and manways to the level below were carried up with the stope. For a while the slow movement of the downcast air was relied upon for ventilation; later, owing to the high working temperatures, air hose and ventilating pipe were installed. Raise interval was so great that air circulation was deficient. The method continued for a few floors. Later on it became necessary to drive intermediate raises to increase ventilation. On the holeing of the intermediate raises, the stopes cooled appreciably. Raises should have been driven close enough to secure good air circulation in the beginning.

Case 4. The orebody was exceptionally heavy and could not be supported over openings of any great width. Drifts were driven, one regular set in width or narrower, along the footwall, an ore pillar being alongside in the hanging wall. Stopes were started off by "drilling from under" and blasting upon turn sheets or lagging floors on the sill. The ore was mucked up between shifts. Rounds were light, so as not to break any more than could be readily mucked up. After a sufficient overhead opening was made, floors were laid overhead and the ground was drilled from this position. Where the ground was heavy, large openings over the

drift sets, caused by caving, were cribbed up. Many miners prefer to knock out cribbing (if not too dangerous), lay floors, and "drill from above" if the ground is suitable. Once the working opening permitted, "stopboards"[1] or slides were put in to facilitate handling the muck. The first floor was then mined out the entire width of the lead, and sets on the ore pillar were cap-silled or sill posts were set upon stringers and spiked. In this case, the pillar of ore on the sill limited the drift opening and controlled subsidence to a great degree. Restricting the width of strike drifts to one set is the most general method used. Note Fig. 3.

Deciding Factors Vary According to Mine

In raise spacing, the deciding factors vary in different mines, veins, and different parts of the same levels. No miner should allow himself to become prejudiced by current practice and stereotyped methods. Some controlling features that might bear closer study are: Size and extent of gouges and their position in an orebody; circulation and control of ditch and underground waters through an orebody; dip of the vein; thickness of the vein; proportion of hard, tenacious rock in a vein as compared to weaker rocks; distribution of ore and waste in the vein; effect of water and moisture on walls and the ore uniformity of rock structure; ventilation; and most economical stope length and speed of mining.

When the sill is well under way and some of the raises are through, stoping operations are begun. Various types of "square-set stopes" from the miner's viewpoint can be classed as follows:

1. Raise stopes, in which raises are driven through at the ends of the stope block and sometimes in between, in the case of long stopes, before or during the beginning of stoping operations, the raises being for ventilation, waste transfer, manway purposes and for lowering or raising supplies into the stopes from the levels. This is the most common type in use.

2. Blind stopes, in which no raises are used, or driven only in extremity after the stope is well under way. Such stopes are seldom finished as such, although some may be up several floors before raising is begun from the stope. Such stopes are exceptions and are not considered good mining practice.

3. Split stopes are occasioned by the presence of waste lenses. If the waste lens is not too great in size, the ore is mined out and the waste rock is blasted down for filling. The entire area mined out is timbered in one stope and may be classified as a regular raise stope. Split stopes may or may not be entirely of the raise type.

Raise Stopes Described in Detail

In starting a raise stope two methods are in vogue. The first is by drilling from under. A further subdivision into two classes can be made. In both the "under" cases drill stagings are rigged up similar to those described before.[2] The two classes differ only in the method of placing the rounds. In the first, a position, illustrated by the sketch, Fig. 4, is chosen preferably at one corner of the stope, so that a round can be drilled and blasted against the raise chute. In the second, a position, indicated in Fig. 5, is chosen in a "solid corner" (the back) of the stope, away from a raise, and a standard raise round put in. In drilling from under, weak timbers or old and partly rotted ones and heavy ground may result in a cave, thereby choking up the manway if blasting is done. However, it is often used, as there is more free surface, with correspondingly fewer drill holes required to blast out the ore; also, it may not be convenient to drill against a raise if doing so would block traffic. In any case the miner's judgment dictates the method of drilling. Blasting against raise timbers and breaking them is avoided at a "solid corner" of the stope, and in starting off the most convenient place can be chosen. The rock is loaded out by building slides under the sets of the round and loading out directly after a blast. This method has as many advocates as the other. It is resorted to only where the back is sufficiently high above the timbers to allow for the increase in bulk of the broken ore over that of the solid, as in the case of cribbed sets and high backs.

[1] A local term for the Chinaman chute.

[2] Article on Raising: *Engineering and Mining Journal*, Aug. 21, 1926.

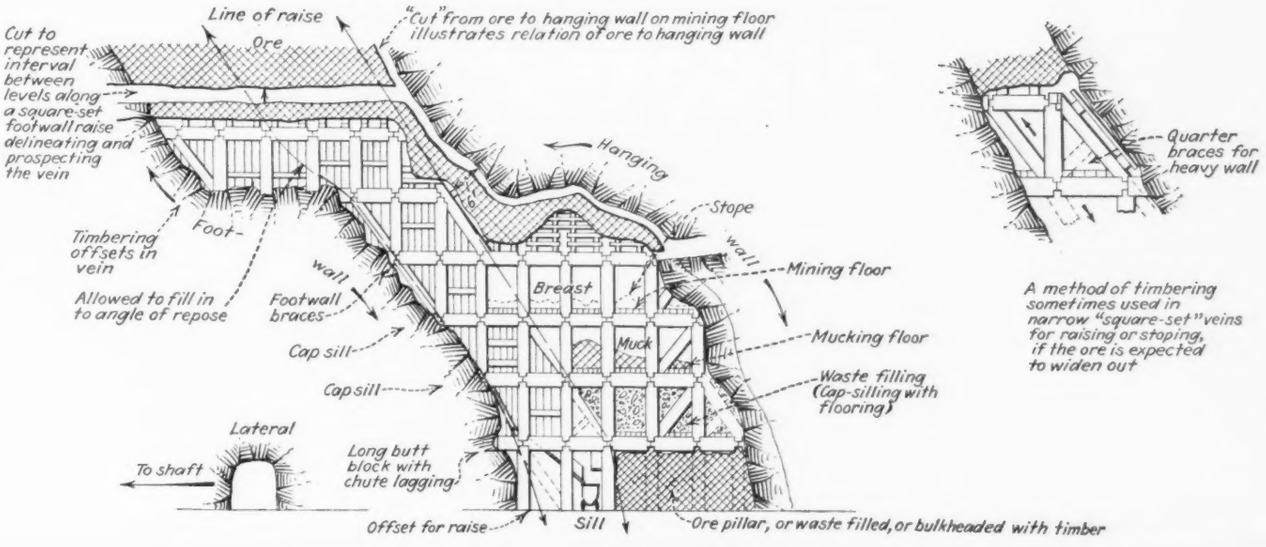

Line of raise
"Cut" from ore to hanging wall on mining floor illustrates relation of ore to hanging wall
Ore
Cut to represent interval between levels along a square-set footwall raise delineating and prospecting the vein
Hanging wall
Stope
Timbering offsets in vein
Foot-wall
Mining floor
Allowed to fill in to angle of repose
Footwall braces
Breast
Muck
Mucking floor
Cap sill
Cap sill
Waste filling (Cap-silling with flooring)
Lateral
To shaft
Long butt block with chute lagging
Offset for raise
Sill
Ore pillar, or waste filled, or bulkheaded with timber
Quarter braces for heavy wall
A method of timbering sometimes used in narrow "square-set" veins for raising or stoping, if the ore is expected to widen out

Fig. 3. Transverse section of stope supported by square-set timbering. Sketch illustrates a footwall raise in a wide vein

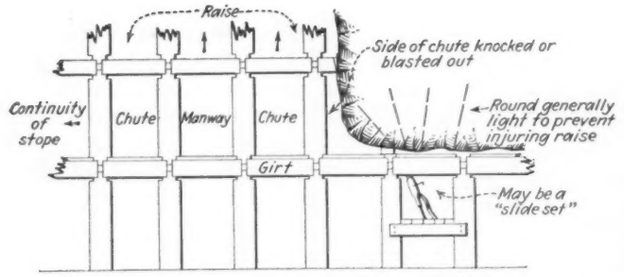


Fig. 4. Sketch showing the significance of the term "drilling from under" or blasting against a raise

In the second method, drilling from above is resorted to. This is seldom used in starting off a stope, although often applied to the succeeding floors. The chute lining of the first set may have to be ripped out to allow of placing a round as indicated in Fig. 6.

Care Needed in Drilling From Under

In drilling from under the ground is often loose, and under such conditions care in drilling is necessary. The safest practice is to place two lagging boards overhead, capwise (in the sets to be drilled) or girtwise, and to shift them around so that they will afford the best protection possible if a fall of loose rock should occur. After the rounds are in, routine practice is more or less observed before blasting, as follows: Covering over manway (may be double lagged); covering over all sill sets in the vicinity of the blast; bracing timbers with stulls; putting in slides under sets; blasting light; the usual blasting precautions to prevent men from being blasted.

In blind stoping, drilling from under is the only method that can be used. Here, as in other methods, slides are placed in the sets to facilitate loading out the ore. Split stopes are similar to those mentioned before, with the exception that they may be worked as two or three separate stopes with a crew of miners in each. In any case, starting-off operations are practically the same as mentioned.

In mining out the first set of ground, the procedure is similar to that described in raising. If sufficient room is not made on the first round, stagings are built and a new round is put in with widening out as shown in Fig. 6 (drilling from above). If the ground only requires plugging, a double floor is laid over the caps of the sill set and it is drilled therefrom. It is generally advantageous to make room for several sets while plugging for timber by drilling from the floor above. Once ample room is secured to allow timbering, and the place is barred and cleaned down as described in raising, a floor is pulled up and the miners rustle their timber and boost it up by hand through the set opened.

A raise set consists of four posts, two caps, and two girts; a leading set of two posts, one cap, and two girts. Once the raise set or the leading set is in, room for successive sets is made by blasting ahead, down on the floor or back-lagging of the sill. In many cases, it is found that in advancing, the sill sets are not lagged over, especially where all timber fits in firm ground, leaving no room for lagging; or where subsidence takes place and broken lagging has been removed but not replaced; also, the sill is frequently firm enough to stand without back lagging before stoping. In any case, a floor must be laid in the sets directly over the haulageways and wherever slides are omitted. This is to keep the muck off the sill and to protect the main air and water lines which supply the whole level. Before blasting, the floors must be repaired by either securing space by putting in plug shots and cleaning up the sill when most convenient, or by using special lagging held up by cleats and reinforced by stulls and headboards when blasting.

If the lead is wide and is delineated by foot- and hanging-wall drifts, the miners sometimes return and take out the ore between the drifts and timber from wall to wall before stoping, or mine the lead over its entire width in the first place. In this case the back is also drilled with plug holes. The foot- and hanging-wall sets, mostly offsets, owing to the pitching of the veins, are timbered with angle braces, cap-sills, or long butt-blocks, as shown in Fig. 3.

Practice in Narrow Stopes

In Butte, stopes vary in width through a wide range —from less than one set wide to over ten or twelve sets. A brief description of the routine in stopes one set wide or less is as follows: (a) Stopes one set wide are worked like wider stopes but are more cramped for space. In narrow stopes, posts and girts are of standard stope timber and the caps are cut to fit the ground. In many instances this involves handwork, although in veins of uniform width special caps may be framed in the shop and sent below. A foot of clearance above the sill timbers in the driving of the sill will make the working of the first floor much easier, as ample clearance between ground and floor makes blasting easier and safer, and the floors and slides are more readily placed. Slides are built in every other set, or they may be widely distributed and "stop-boards" used to load out the rock.

Working out the first floor of the stope is generally considered the hardest part of stoping. Over regular sill sets it does not entail a great deal of trouble, with good men, if precautions such as bracing timbers are observed. Special care is necessary in working out over double-track or switch sets where long caps are used. In timbering the first floor of stopes, standard

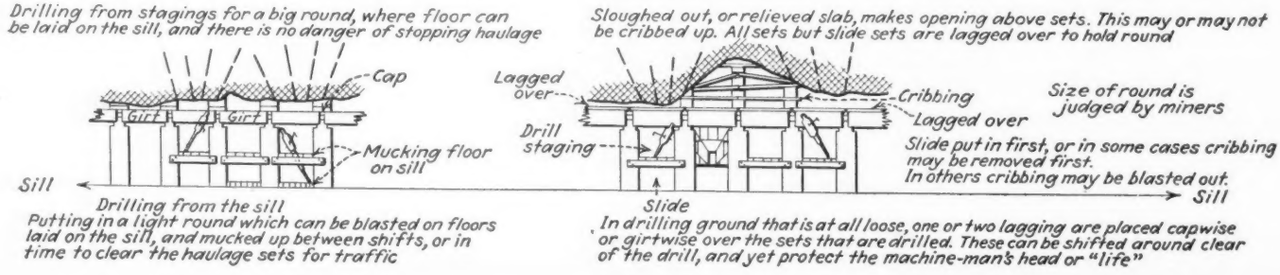

Drilling from stagings for a big round, where floor can be laid on the sill, and there is no danger of stopping haulage
Cap
Girt
Girt
Mucking floor on sill
Sill
Drilling from the sill
Putting in a light round which can be blasted on floors laid on the sill, and mucked up between shifts, or in time to clear the haulage sets for traffic
Sloughed out, or relieved slab, makes opening above sets. This may or may not be cribbed up. All sets but slide sets are lagged over to hold round
Lagged over
Drill staging
Cribbing
Lagged over
Size of round is judged by miners
Slide put in first, or in some cases cribbing may be removed first. In others cribbing may be blasted out.
Sill
Slide
In drilling ground that is at all loose, one or two lagging are placed capwise or girtwise over the sets that are drilled. These can be shifted around clear of the drill, and yet protect the machine-man's head or "life"

Fig. 5. Sketch showing the "drilling from under" of a "solid corner" or in the back above the sill floor

stope timbers are used as shown in the sketches accompanying this article.

No trouble, in general, is encountered in timbering the first floor, as timbers are more or less well aligned. All timbers are side and top blocked. It is essential that blocking should have a firm bearing and should be of ample size to hold all timber members, as careless blocking almost always results in loss of alignment and loosening of the timber; in some stopes where timbering is careless, sets can be observed that are so warped and loosened that every blast takes out one or more sets. Fortunately this is the exception. When stope sets become greatly out of alignment it is almost impossible to hold the timber during a blast, as there is little contact surface between members even when hand-framed. Under such conditions it is necessary to retimber the mining floor with stringers and to place new timbers in line.

In starting the second stope floor the routine is similar to that already described, with the exception of heavier blasting and a corresponding increase in the stope tonnage as a result of the ground breaking easier and falling to the first floor, where it is out of the way of the miners, who can then either drill or timber. The starting of the first mucking floor also allows the introduction of muckers into the stopes, where they can handle the rock much quicker and are not in the miners' way. Where slides (Fig. 9) are placed in every other

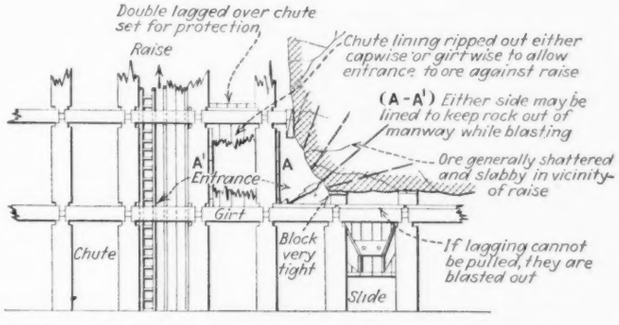
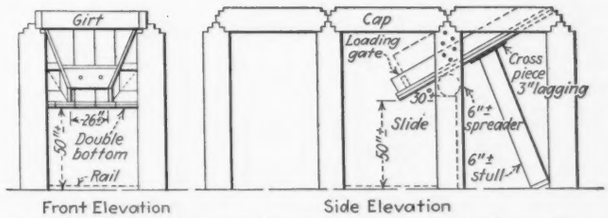

Double lagged over chute set for protection
Raise
Chute lining ripped out either capwise or girtwise to allow entrance to ore against raise
(A-A') Either side may be lined to keep rock out of manway while blasting
Ore generally shattered and slabby in vicinity of raise
A'
Entrance
A
Girt
Chute
Block very tight
If lagging cannot be pulled, they are blasted out
Slide

Fig. 6. Sketch showing significance of the term "drilling from above"

set, the removal of the muck is greatly facilitated. With a greater slide interval, or where very few slides are put into stopes, stop-boards are used. The floors may or may not be double lagged, excepting a 12-in. space directly over the center of the track. To cover this space during a blast, short pieces of lagging, 3 in. in thickness, are laid crosswise. After a blast a number of these cross pieces are pulled up and the muck is shoveled into cars on the sill tracks below. Stop-boards economize in the use of slide timber, but are slower in handling rock. With slides as much as ten cars of rock can be temporarily stored and readily drawn. With stop-boards, the rock is mucked directly into cars. This may prove inconvenient along haulageways and requires more time to load a trip. Muck is continually falling on the sill, which impedes traffic and causes extra work. If timber is fairly cheap and plentiful the extra cost of slides is compensated by greater mantonnage. Slides or stop-boards are used until the sheeting and permanent chutes are installed, which is generally after the second floor has been worked out.

Mining out the second floor is more or less a routine of drilling, blasting, timbering, and mucking. Before



Construction of slide used as a temporary structure to facilitate loading out broken rock. Angle of slide, 30°± (2"x7"-10") Chute lagging are used for construction. Where blasting is comparatively light, the bottom is of single thickness

Fig. 7. Construction of chute mouth and details

blasting the timbers immediately behind the blast are reinforced by lacing the posts together.

There are no restrictions generally upon the use of explosives and primers other than the judgment of the miners themselves. Judgment is a decidedly variable factor. Experienced miners are good judges of ground, rounds, and explosives; others to whom mining is merely a means of eking out an existence trust more to luck than to experience. Ground and rounds drilled are such variable factors that it is impossible to describe any current standard practice.

Before a round is blasted, the mining-floor lagging boards directly under the blast are pulled up and single or double lagging are laid along the caps and girts and often spiked, to prevent smashing the timbers from heavy blasting. A grizzly of double lagging is sometimes spiked cap to cap in the center of the set to break the fall of blocky rock to the mucking floor. Sometimes the ground rides the timbers and makes it impossible to remove the lagging. In this case it is best to blast them loose before the round goes off, if they are not already cracked or broken, as this relieves the strain upon the timbers when the bottom holes are blasted and allows the falling rock to loosen and relieve itself.

In heavy ground or where a stope remains idle for some time, stope timbers may split or shear as a result of the settling of slabs of ground. It is not convenient to replace them before the stope advances, and they must therefore be reinforced when near the blasting, for their failure may cause a number of other sets to swing and fall out as the result of concussion and slabbing of the ground in the vicinity of the blast. They are reinforced by doubling up or by using stulls and headboards and also bulkheads or cribbing.

After the blast the usual routine is as follows: (a) Cleaning and repairing mining floors. Loose and broken lagging are replaced and often spiked down to prevent accidents by falling through a floor. (b) Barring down. After the floors under the timber are fixed the miners bar down with pick and pinchbar all loose slabs and drummy ground from the back, walls, and the face of the stope. Often the ground is habitually loose and drummy in spite of long barring. In this case the miners lay floors over all open sets ahead and take a little care. If the ground should be unusually dangerous and conditions warrant the delay involved, stringers, or in some instances discarded guide timbers, are carried into the dangerous place and erected as a shield or guard for the men working ahead of "timber." If the ground should start they will give protection or warning to "get out." The crack of a lagging overhead when a mass of rock breaks loose and falls is often ample warning for any one working on the floor below

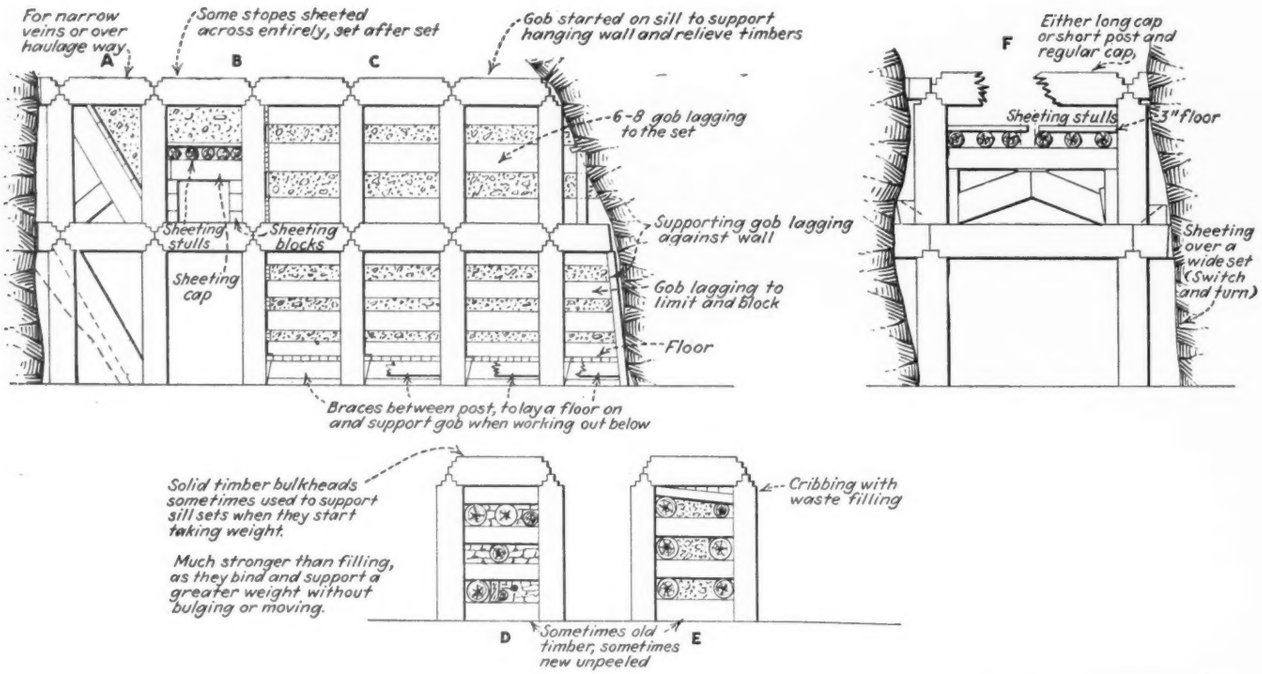

For narrow veins or over haulage way
A
Some stopes sheeted across entirely, set after set
B
C
Gob started on sill to support hanging wall and relieve timbers
6-8 gob lagging to the set
Supporting gob lagging against wall
Gob lagging to limit and block
Floor
Sheeting stulls
Sheeting blocks
Sheeting cap
Braces between post, to lay a floor on and support gob when working out below
F
Either long cap or short post and regular cap
Sheeting stulls
3" floor
Sheeting over a wide set (Switch and turn)
Solid timber bulkheads sometimes used to support sill sets when they start taking weight.
Much stronger than filling, as they bind and support a greater weight without bulging or moving.
Cribbing with waste filling
D
Sometimes old timber, sometimes new unpeeled
E

Fig. 8. Method of supporting waste filling. "Sheeting" is a local term to signify the bottom support or "floor" of waste-filled square-sets

to move fast, especially if he understands the condition of the ground under which he is working. The 3-in. lagging boards generally used in Butte are sufficiently strong in most cases to hold any loosening ground if it is not too great in amount or does not fall too far. The experienced miner will continually watch his ground and be warned subconsciously by many small signs of approaching failure. (c) Drilling. This may be divided into two parts: the main round and plugging for space in which to erect timbers. Frequently the main round will not break high enough for timber. Shallow plugs are then drilled and blasted to furnish the necessary clearance. Most miners will drill "main round" through the shift and blast when going off. In "plugging" for timbers the first half of the shift is spent in drilling, the holes being blasted at lunch time, and the second half is spent in rustling timber and timbering.

Blasting in the middle of the shift is not considered good practice, especially in the deeper workings where air circulation is more or less sluggish, as the half hour allowed for lunch is insufficient, in many cases, to sweep out powder gases and dust resulting from blasting. Under such circumstances the men suffer severe headaches and sometimes sickness. It has therefore been found best to drill throughout the shift, when circumstances permit. Timber is landed in the stopes either by lowering from the level above through the raise manway, by hand, or by hoisting from the level below by air hoist, or by hand.

After the timber is landed in the stope, the miners or timbermen clean and prepare the mining floor square-set mortises to fit the post. In practically all cases the theoretical square-set mortise is more or less warped from rock pressure and irregularity of the floor. The surfaces are trued up by chipping off the high spots with an axe. Posts are erected with the butt or thickest end up to give greater bearing surface to caps and girts. Stagings of blocks and lagging are built up as necessary, and the caps and girts raised into position from them; if posts are unusually heavy and unwieldy, they are laced to the sets already in place by lagging nailed post to post, near the top. The lacing of timbers is optional. To cite extremes, I have seen a man lift a heavy cap into place by himself; again, four men have strained to lift a much heavier cap into place, although of the same dimensions. Miners avoid handling heavy timbers, although when the lighter ones are all used up there is no choice.

THIRD AND SUCCESSIVE FLOORS

In mining out the third and successive floors, the routine of starting off and of timbering is similar to that previously described. The third-floor chutes and manways are carried up and preparations for gobbing are begun. Repair men are sometimes assigned to the last-named work on the completion of the second and third floors by the miners. Otherwise the miners themselves work out the third floor and prepare the stope for gobbing.

Slides are ripped out and standard chutes are constructed as in Fig. 7. The chutes are then lined, up to the mucking floor, with standard chute lagging. A standard chute interval is every fifth set. In some of the mines the practice is to put a chute and manway in every third or fourth set. Chutes in other instances are widely separated, and wheelbarrows are required to transfer the ore to the chute. This is the exception rather than the rule and may be resorted to only in the case of a doubtful orebody. Rock transfer is facilitated by the liberal use of slides from the mining floor to the mucking floor in the direction of the chute. Slides are not much used in Butte at present, as the rock is handled by hand to facilitate sorting.

In starting off the gobs in various stopes, the set over the sill is sheeted, to form a support for the waste filling, by the use of standard sheeting blocks and poles,

or stulls, and 3-in. lagging, as shown in Fig. 8 at *B*. This procedure is used in wide leads, over double tracks and switch sets. Suspected side pressure, or top pressure, entails placing sheeting girtwise to facilitate replacement of broken timber. In sheeting narrow stopes, one set wide or greater, the former method can be used, or diamond braces with sheeting poles and regular lagging may be substituted. The diamond braces are supported in the middle by quarter braces. Exceptionally wide stopes are not as a rule sheeted across entirely; only the haulage sets and those used for storing supplies or required for other purposes are kept open by sheeting. In the other sets, waste filling begins from the sill. The gob is supported on the sill, by putting braces between the sets to be filled and laying floors across the braces as shown in Fig. 8 at *C*.

Sill sets, to be filled, are poled off from open sets by regular 2 by 6 in. by 5 ft. 4 in. gob lagging or by peeled-pole lagging. These sets, when filled, form a pillar to support the hanging wall and to prevent lateral movement. Gob pillars are not always used (where ground is exceptionally heavy), and solid timber bulkheads (Fig. 8, *D*) are constructed instead to limit subsidence and lateral movement. Of the two methods the solid timber bulkheads are the most substantial, albeit the more costly.

Cribbing with waste filling is seldom used in Butte for permanent supports, although cribs without filling are often used on stope mucking floors where there is unusually heavy ground, to support the ore above. They are removed and replaced elsewhere as needed when the floor advances. They can readily be removed and replaced if properly put in, and if made up of standard mine timbers their use does not result in the accumulation of wood in the gob, with the resultant danger of fires where there are sulphides in the gob and ore. The timbers can be used on the floor above as needed. Fig. 8, *E*, represents bulkhead and crib construction.

Placing Sheeting

In sheeting operations all necessary supplies are gathered and pulled up by hand. Sheeting caps are first put into place upon sheeting blocks and then tightly wedged into place. They are of either square or of rough, unpeeled timber. When a number of sheeting caps are in place long sheeting poles or stulls are placed across them to bind various sets together. On the top of the stulls are laid floors of standard 3-in. lagging. The gob rides on the floors. While the sheeting is being laid, the stope limit is gobbed off, with standard gob-lagging (2 by 6 in. by 5 ft. 6 in.) or with poling. Filling operations are begun by changing the raise chutes into waste chutes, hoisting an ore car into the stope by chain block, and laying light rails from the lip of the waste chute through the stope. Some stopes—as, for example, those having chutes at intervals of five sets—are filled without employing cars and track in the stope. In such cases, the sets immediately above the waste chute are filled by allowing the waste to run freely from the chute, leveling off the pile by mucking, and then laying floors upon which the waste filling is run over the filled sets and mucked into adjoining sets between chutes and from foot to hanging wall.

Raise chutes are prepared for waste handling by ripping out the chute lining to the mining floor and putting in a slide similar to the ore slide used on the sill. This is generally done by repair men. Once the slide and stop-board are put in, waste is dumped into the chute from the level above, and the waste slide stop-board is pulled and waste rock allowed to run wild until it reaches its angle of repose in the sets immediately adjacent to the slide. The slide is then stopped and the waste leveled to the tracks by mucking. The waste car is then used to distribute the waste to the extremities of the stope.

In a great many stopes, especially when up several floors, the timbers are not in perfect alignment; to lay a fairly level waste car track requires ingenuity. Tracks are therefore not laid directly on the caps or girts but on lagging spiked to posts. As most curves are more or less right-angled, rails are chosen as light as possible, not alone for economy but to facilitate handling and bending. Rails are bent by placing between two posts and bending.

Waste is derived from development work (drifts, raises, crosscuts, and shafts) and from waste-picking in the stopes and on the grizzlies of the station ore pockets. In some stopes where ground is not troublesome, keeping up the waste is not of major importance; however, if the ground or hanging wall shows any tendency to shift and timbers start swinging, it is vital that the waste be kept up to the shoveling or mining floor. The finer the material the more substantial the gob pillar will be. However, if the waste rock is too fine, any leakage of water into the gob causes swelling, which may endanger the sill by the increased pressure.

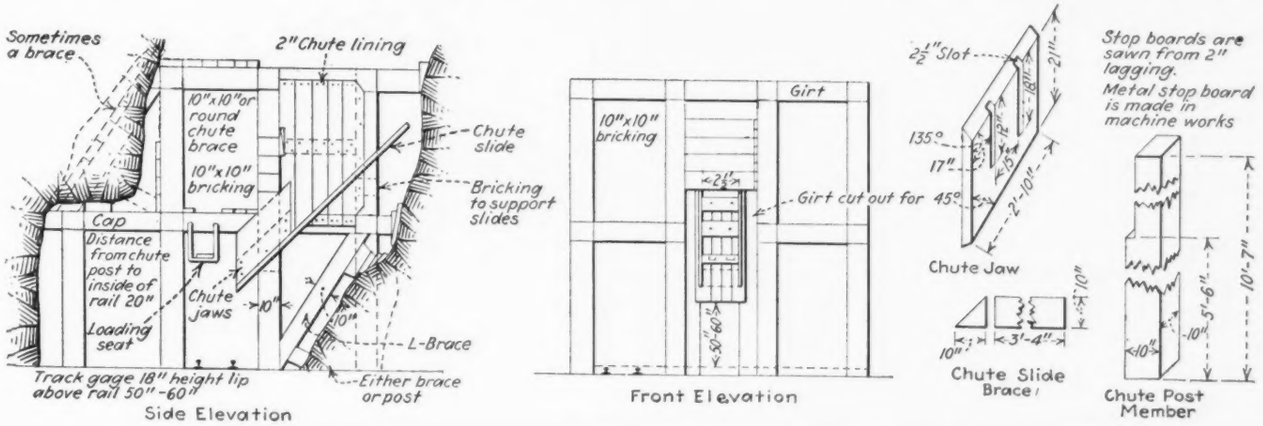


Fig. 9. Construction of temporary slides used to facilitate handling of broken ore

Angle of slide, 30 deg. + (2 in. x 7 ft. 10 in.). Chute lagging is used for construction. Where blasting is comparatively light, the bottom is of single thickness.

Swelling of gobs manifests itself in the immediate vicinity of ore chutes, manways, and sheeting. In one case of my experience, a water hose which had leaked for a week caused such swelling as to completely crush in an ore chute and manway overnight. In waste filling it is important that all floors and lagging be removed and that the hanging-wall sets be thoroughly filled, to prevent shifting and breaking of the hanging wall.

In mining successive floors the routine is the same. In waste filling, the stope limits are poled off, waste slide is constructed, track laid, and the floors (mucking) are pulled up after the mining has receded from the chute where the stope was started. The car is then hoisted to the floor above by chain blocks. No variation of the foregoing routine is encountered unless the stope begins to cave, or until within two or three sets from the sill above. The former case will be considered later. In the last-named case the ground begins to loosen up, partly as a result of proximity to the sill above or to possible "working" gobs of the level above, or to subsidence, lateral displacement, and weight. When the stope starts showing customary signs of weakness, care must be taken in blasting and in keeping up the timbering. If the stope shows signs of taking weight, the regular timbers are reinforced by cribbing, waste if it is available, is kept up to the mucking floor, and over-riding slabs are mined out as soon as possible, to relieve overhead weight on the timbers—also, one or more manways are maintained in good condition for a "quick" exit. There are very few old-timers in Butte who have not at one time or other forgotten bucket and jumper in their anxiety for a fast exit. In general, a dangerous working place can be detected by such things as "timber talk," rock noises, and working of the ground. One thing not so easy to detect is the time to leave. This uncertainty, and not lack of warning, is what generally entraps men.

In mining out the last floor, care and judgment are necessary to prevent wrecking of the sill above and the releasing of the gobs of the level above. The sill is reinforced by going over the blocking and bracing all the sill members with stulls. In reinforcing, stringers, blocking, and stulls are used, as shown in Fig. 2.

In taking out the ground, careful, light blasting is practiced, and in some cases no blasting is allowed, but picking and barring are the rule. Only one set of ground is worked out at a time, and it is immediately timbered. Once the regular timber is in, it is essential that all loose members of the sill above be caught up with stringers (short) and blocking (sill posts, chute timbers, ties, and tracks). This is done by filling over the regular set (with odd sizes of timbers) and under the sill members and firmly blocking to keep them in place. When the sill set is mined out, and all sill timbers are caught up, the last floor is filled with waste to the sill track level. This completes the stope. The last floor of a stope may come to the regular set, or "pup sets" may be necessary.

In many instances side pressure in stopes, even in filled stopes, causes displacement of timbers, which destroys the uniformity of the stope level even with careful top blocking. In others the stope timbers are so out of alignment as to require the laying of a new sill with stringers on the gob and sill posts (rare). Sometimes special length posts are ordered to level up the floor above. In the lateral warping of the stopes, the original square-set joints may be so weakened that the timber will not hold up unless hand-framed, which is slow and tedious, especially with dull tools. The settling and swelling of the gob causes more shifting of timbers and squeezing or crushing in of sills. This is often remedied by driving laterals and crosscutting to the old sill.

Acknowledgment is gladly made of the co-operation given to me by C. W. Berrien, Michael Gavigan, and Edward Renouard in the preparation of this article.

Should Fluorspar Be Sold Upon Analysis?

Fluorspar is bought by the makers of basic open-hearth steel only for its content of net calcium fluoride. Therefore, the analysis (now standardized) of 85 per cent calcium fluoride and not to exceed 5 per cent silica, gives net calcium fluoride of 72½ per cent, after allowing a reduction of 2½ points of calcium fluoride for each point of silica, as practiced by the leading steel companies.

In regular practice calcium fluoride runs evenly 85 per cent or a trifle over, whereas silica, owing to the nature of the deposits of fluorspar, varies from 1 to even as high as 8 per cent. This is shown by the accompanying tables.

Calcium Fluoride, per Cent	Silica per Cent	Equal to a Net Calcium Fluoride Content of, per Cent
85	1	82½
85	1½	81¼
85	2	80
85	2½	78¾
85	3	77½
85	3½	76¼
85	4	75
85	4½	73¾
85	5	72½
85	5½	71¼
85	6	70
85	6½	68¾
85	7	67½
85	7½	66¼
85	8	65

Calcium Fluoride (Ignoring Silica) per Cent	Cost at Mine, per Unit, Based on Fluorspar at $20 per Short Ton at Mine, Cents
80	25.00
81	24.70
82	24.40
83	24.10
84	23.80
85	23.53
86	23.26
87	23.00
88	22.73
89	22.47
90	22.22

Silica, per Cent	Reduction in Calcium Fluoride, Points
0	0
1	2½
1½	3¾
2	5
2½	6¼
3	7½
3½	8¾
4	10
4½	11¼
5	12½
5½	13¾
6	15
6½	16¼
7	17½
7½	18¾
8	20

The higher the net content of calcium fluoride, the less fluorspar used. The only other impurity of any consequence, provided sulphur is practically eliminated, as is generally the case, is calcium carbonate (lime), which, though not objectionable, when paid for in fluorspar, is too costly.

Until the present high cost of mining and concentrating fluorspar developed, not much attention was paid to its analysis, but conditions are different now, and the price justifies close attention to the quality both in buying and using.

Ore Deposits of Chile—II*

By James E. Harding
Mining Engineer, Lyme, Conn.

THE Ojanco Nuevo district, near Copiapo, consists of two slightly convergent parallel dipping fissures with an interlacing stockwork of connecting parallel fissures in two directions. The main convergent fissures carry the principal mineralization, but there is one instance where the mineralization forsakes the main fissure and follows a crossing fissure. While the district has not been a large producer, it typifies the complexity of faulting and mineralization. See Fig. 5.

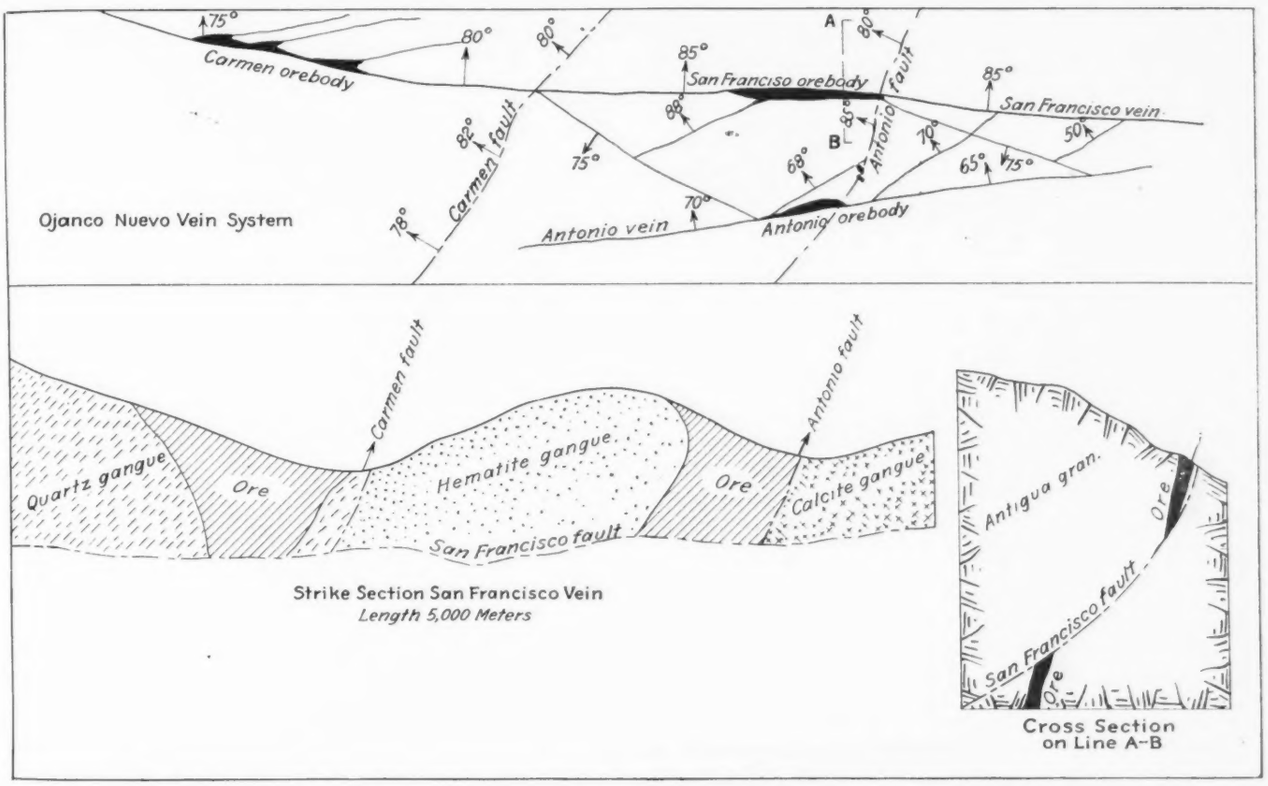


Fig. 5—Above, Ojanco Nuevo vein system, near Copiapo. Below, a section of San Francisco vein along strike

In the workings it has developed that the gangue of the north end of the veins is calcite, the central portion of the veins is hematite, and the south end is very siliceous—all on the same horizon. This result was produced in part by faulting and in part by erosion—that is, on surface by erosion and at depth by faulting. A double fault, at nearly right angles to the strike of the vein, overthrust the south end on the north end. After that an overthrust fault parallel to the strike of the vein, but dipping at a much flatter angle, cut the vein off completely, moving the upper portion up and over the lower portion for a distance of about 200 meters, measured on the dip of the fault. After the fault, considerable siliceous vein matter was deposited, with also a little copper, in the fault shear, making in that a small vein; also some fragments of drag ore, of fairly large size, were left along the fault shear.

Workings were started on the outcrop, on a well-mineralized vein about 2 meters wide, and continued down for 30 meters on good ore. Suddenly the ore gave out and the vein supposedly changed its dip. The fault paralleling the vein had been encountered but not recognized; and was followed down for over 200 meters. Occasionally fragments of rich drag ore were encountered, which each time were thought to be the new orebodies sought. Finally ore was encountered in the footwall of the fault, although this was not recognized as the other section of the vein which had been lost at the 30-meter level. Water was encountered with the ore, inadequate pumps were purchased, the capital of the company was spent, and the lower portion of the vein has as yet not been worked.

Punto del Cobre District

Punto del Cobre district lies in the Copiapo Val[illegible] 18 kilometers above the town of that name. The Salado lavas lie on Antigua granite, and a formation of Travertina limestone about 150 meters thick surmounts the Salado series. Nearly vertical veins come up through both the granite and the Salado lavas, seldom over a meter in width and not well mineralized. When the veins arrive at the contact with the Travertina measure, large and high-grade orebodies were formed by replacement. Erosion carried away much of the Travertina, the original chalcocite was meanwhile oxidized to cuprite, and some extremely rich orebodies outcropped almost on surface.

*The first installment of Mr. Harding's article appeared in the July 23 issue.

Formerly, in the Puquios district, a large number of small mines were worked, but the ore was low in grade and carried much arsenic, which made it generally undesirable at the smelters; and therefore the mines were generally of but little value. The reverse, however, was true in case of the Mina Dulcinea, whose shaft reaches a depth of 1,034 meters; and the mine was

Fig. 6—Copper outcrop in Shinto sandstone

without question the most valuable vein deposit of copper ever developed in Chile. As worked, the ore lies entirely in a faulted block, the vein was from 1 to 5 meters in width and the oreshoot about 200 meters in length, going down to a depth of over 1,000 meters. The inclosing rocks are the lavas of the Salado complex resting on Antigua granite. At the bottom, the ore consists of primary chalcopyrite with a small amount of specular hematite gangue, with some calcite, and veinlets of molybdenite, all primary minerals. The ore carries about 25 per cent copper.

The Cuba District

Chiefly interesting from the fact that it is the only copper district in Chile in which good values in gold were encountered with the copper is the Cuba region. The inclosing rocks are the Salado lavas, and the veins are siliceous replacements of gouge, up to a width of over 2 meters. Several veins were worked, giving an ore containing both gold and copper. The oxidized zone was chiefly productive, with a thin zone of secondary enrichment, which gave place at a depth of about 200 meters to a primary mineralization of pyrite, chalcopyrite, specular hematite, and quartz. The primary ores run only 5 grams of gold and about 1½ per cent copper. This district is in the Chañaral drainage area.

The Pueblo Hundido District

In the Pueblo Hundido district are several veins consisting almost entirely of specular hematite, sometimes with calcite in the upper regions and carrying small amounts of copper—such small amounts, in fact, that were it not for the value of the iron as smelter flux, none of the veins could have been made to pay their working expenses. Thin zones of secondary sulphide enrichment have also been encountered in these veins.

The Salado-Las Animas District

At one time the Salado-Las Animas district was the most important copper producer in Chile, extending along the west side of the great Salado fault, from Carizalillo on the north to Algarobo on the south, a distance of more than 180 kilometers. Carizalillo was a chimney-shaped orebody in Intruso granite, where several radiating fractures met, about 30 meters in diameter and 400 meters deep, producing a large amount of about 4 per cent concentrating ore, from a well-developed sulphide zone. In general the veins of the sulphide zone were primary replacements of gouge, and the orebodies worked were superficially enriched oxide material. In many cases, notably in the Mina Limbo, Manto Verde, and Tulipan, excellent bodies of sulphide ore were encountered, and a considerable tonnage was extracted.

El Tigre District

As far as I know, the El Tigre mine is the only orebody ever encountered in the Cortadera limestone. This district lies well back in the Cordillera, at an altitude of 4,500 meters, about 10 kilometers from the Argentine frontier. A Caballo dike, about 20 meters wide, splits through the Cortadera limestone, and on both sides of the dike a high-grade chalcocite orebody was formed by replacement. Large masses of the ore completely replaced the limestone and assayed as high as 75 per cent copper. One bed of limestone is replaced for a distance of about 15 meters from the dike, but the general replacement does not extend out into the limestone more than a meter.

In the Shinto sandstone there are several prospects but as yet no mines. Of the several outcrops of copper veins in Shinto sandstone, some are of impressive length and width. The Shinto formation at the location of the accompanying illustration (Fig. 6, "Copper Outcrop in Shinto Sandstone") will be about 150 meters thick. I confess to a great curiosity to know what will happen when this fissure reaches the Cortadera limestone, which, geologically, would be a most ideal location for a replacement orebody.

In nearly all the veins in which a sulphide ore zone has been found, one almost universal condition has been encountered—that is, a nearly completely barren zone between the rich oxide orebodies and the sulphides. To account for this I have a theory as follows: During the time of heavy rainfall, succeeding the Caballo Muerto volcanic cycle, erosion was deep and leaching thorough. At the end of that period the veins existed as sulphide orebodies with heavily leached outcrops, still carrying a very small percentage of copper. Then succeeded a cycle of aridity, and the small amount of copper remaining in the outcrops was slowly dissolved, as fast as erosion removed the surface, and lacking water for transportation was reprecipitated slightly below the surface by molecular attraction and desiccation. This presupposes lack of circulation from surface down to the permanent water level, a condition which I believe has obtained, and produced the separated oxide and sulphide orebodies which have been almost universally found.

In some cases, post-mineral warping of surface has elevated sulphide bodies above the water level and in others depressed the oxide bodies below water level, but in general sulphide and water are encountered simultaneously. Along the walls of the fissures, in some cases, disseminated orebodies have been produced, but no sizable tonnages have as yet been developed as a result of this.

Silver Deposits

From 1850 to 1878 silver mining was the flourishing industry of Chile. Many large and rich mines were exploited, and large profits were made. The latter of the two dates given saw what was practically the end of the industry—for two reasons. One was that many of the mines had been worked out; and the other was that the three-cornered war in which Chile, Peru, and

Bolivia were involved, known as the War of the Pacific, came on. That war drew away what men were working the mines, and after it was over the financial chaos into which the country fell tied up capital for some time. Then it was found that copper mines could be worked at a better profit than the silver mines; so the silver mines remained practically shut down. The copper mines in turn received their death blow when the nitrate industry came into being.

During the last fifty years sporadic attempts have been made to start up some of the abandoned silver mines and put them again on a producing basis; but all such efforts have ended in failure. The capital raised has been largely used up in other ways than in the mines themselves, the companies have not had the advantage of good technical direction, and no ore of importance has been found in the few workings driven.

Serious attempts have been made on the part of American capital to acquire enough property in some of these silver districts to make it worth while to start an exploration campaign, but owing to the fact that practically all the titles are held by the many heirs of the original locators and owners, that many small holders ask ridiculous terms, and that many known owners of title cannot be located, such efforts have been abandoned. Chilean title law also recognizes heritage rights of both legitimate and illegitimate children, which adds complications to any clearing of title, and there is no statute of limitations; this altogether does not present an attractive prospect, with the threat of limitless lawsuits in acquiring property held by ancient titles.

Romance and Silver Discovery

Practically all the silver prospects were discovered by the desert-dwelling goat-herders or animal packers in their various trips to and fro. As a rule the discovery consisted in stumbling over an outcrop of blackened native silver and cerargyrite, sticking out of the ground; and the discoverer is usually credited with carrying the heavy black material to the nearest town and asking publicly what it was.

There is an interesting romance of intrigue, treachery, fidelity, ingratitude, and gratitude attached to the discovery of nearly every mine; and probably in the many years which have passed these romances have lost nothing in the telling. The stock romance is that a thinly clad and shivering Indian, huddled over his scanty fire, noticed that the black rocks which he had piled about it melted and ran out in streams of shining metal, with which, as soon as it had cooled, he hastened to his patron, who immediately acquired the mine, made the Indian wealthy, and he lived in happiness ever after.

Other stories there are, of an aged hermit, who secretly worked the mine for years, and finally was tracked to its location and murdered.

Also there are romances of lost mines, which are discovered, and which the discoverer could never find again. Altogether, these lost mines are over a dozen in number. One such romance is worthy of perpetuation. During the time the South American countries were fighting to throw off the yoke of Spain, two Spaniards, (one of whom was named Juan Lay, Juan Lahite, or Juan Laite—accounts differ as to the spelling) were suspected of being Spanish spies in Copiapo, and to avoid being hanged they took horse and fled to the desert in the direction of the Argentine. They rode for two days and became lost, but finally found an Indian who agreed to guide them on their way. They made a night camp in a gulch, in sight of the Salar of Pedernales. In the morning they noticed that the stones about their fire had melted and that a few feet away was an outcrop of native silver "four fathoms wide." They hastily loaded their pack animal with the metal and proceeded on their way to the Argentine, where they were captured and shot as spies. Before dying, they gave to the priest who administered the sacrament for those about to die, a map of the location and a description with directions how to reach the outcrop, as well as the silver which they had brought with them. The priest set out to find the vein, but without success, and he later went insane. Since that time hundreds of expeditions have been in search of that vein, but no one has found it. Every miner in Chile knows the story by heart and it has been told to me a hundred times without the variation of a single detail. The origin of the story is probably pure fabrication, but it goes to show that romance is not dead.

During the time that the silver mines were being worked the entire country was thoroughly prospected from the Cordillera to the coast. Capital for such work was abundant, and expeditions of as many as forty men were kept continually in the field for months. No mines, as far as I know, were discovered by such expeditions.

No analogy can be drawn from one silver mine to another, and they are similar only in their mineralogy. It is true that they are located nearly on a straight line, starting in with the Descubridora in San Felipe and ending with Huantajaya, near Iqique, 2,500 kilometers to the north; but they do not follow any continental lines of structure and faulting as do the copper mines, nor are they limited to any single formation. They have been found in the case of Cifuncho, in Costina shale, the oldest; and Chanarcillo, in Cortadera limestone, the youngest; and ore has been found in all types of rock from acid lavas to basic limestone. It is, however, true that the largest and richest orebodies have been found where the veins cross very pure limestone beds.

Chanarcillo

Chanarcillo is situated about 60 kilometers above the town of Copiapo, in a valley tributary to the river. In a low, rounded hill one main vein and several smaller veins occur. The hill itself is made up of intercalated beds of Submarino andesite and Cortadera limestone, which have local names such as "Manto Ahuesado," "Panizo Verde," and "Panizo Azul." In the andesite the veins were narrow and worthless; but in the limestone they were wide and rich. Two beds of limestone were productive. Workings were sunk to a third bed; but little ore was produced from this measure, and in fact it was little prospected. Stories there are that it carried rich ore, which is hard to believe in view of the fact that the workings were abandoned.

Whitehead studied the ores from this district and gave a most illuminating paper on them in *Economic Geology*, Vol. XIV, pp. 1-36. He predicates four stages of primary mineralization, each separated from the other by an appreciable interval of time. The first was calcite and barite, the second zinc blende with a little proustite, the third arsenopyrite with a little proustite, and the fourth was by deposition of proustite, pyrargyrite, and tetrahedrite, with freybergite. Oxidation and enrichment followed, with argentite, stephanite and polybasite replacing and enriching the proustite and pyrargyrite; and the supergene minerals were themselves replaced and oxidized to native silver and dyscra-

site, cerargyrite and other halogen compounds. A marvelous orebody resulted, and it is probably safe to say that the most wonderful silver mineral specimens which the world has seen came from this district. Some of the proustite crystals recovered were especially notable. I have seen one which was perfectly crystallized, clear and transparent, 15 cm. high and 5 cm. through the base. The collections of the Copiapo School of Mines, at Copiapo, and the University of Chile, at Santiago, embrace some truly remarkable specimens.

Reliable production figures are not available, but this district probably produced about 750,000,000 oz. of silver.

BUEN ESPERANZA

The largest single silver mine which Chile ever saw was Buen Esperanza. It is located almost on the top of the Chimbero anticline, which is the top of the watershed between Pueblo Hundido and Copiapo, and was abandoned many years ago. The workings are inaccessible, and no accurate data can be obtained regarding it.

Judging from what one may see on surface the ore deposit was a stockwork vein about 30 meters wide and 1,500 meters long, and so much of the material was stoped out that the remaining mass collapsed. It is said that there were over 8,000 separate stopes in the mine and that the workings were so extensive that men were lost and wandered for days within it until they were found and rescued. Apparently the workings were driven down to a depth of about 200 meters only and there stopped for some unknown reason.

Judging from what one may see on a surface much buried under gravel, the locus of the orebody was in a fault where Antigua granite has been overthrust on Costina shale or the Salado Complex.

TRES PUNTAS

The Tres Puntas district is on an extension of the same veins which made the Buen Esperanza and is about 4 km. to the north of that mine. Some rich ore was taken out of two narrow veins in the Salado Complex.

FLORIDA

The Florida mine consisted of one narrow vein of rich ore, in which the minerals were native silver, proustite, and argentite. This vein was in Travertina limestone; and the Travertina measure had been bent into a closed fold before the arrival of the ore, and is much contorted. The vein was followed down in the joint planes of the Travertina, irregular in dip and a few meters away from a contact with a lava measure which is also folded together with the Travertina.

A remarkable fact about this vein is its change in character where it leaves the limestone and goes into the lava. Within two meters along the strike it changes character completely. In the limestone it is narrow, and schistose, with a gangue of secondary calcite with silver minerals; in the lava it is about four times as wide, and carries copper minerals in a gangue of hematite and quartz.

GOYENECHEA

Goyenechea was a small but rich mine, about 36 km. to the north of Florida, but different in every way. A wide Barezo dike cuts through the Salado Complex, sometimes as a dike and sometimes as a sill. On surface the ore outcropped on the east wall of the dike for a distance of about 30 meters only. Going down to a depth of 20 meters, the vein followed the dike and then cut sharply across it to the other side, at which point a body of native silver was encountered a foot in width and about 10 meters in length. This mass of native silver was the kernel about which was grouped a complex mineralization carrying nickel, cobalt, bismuth, and arsenic, with cobalt bloom very prominent. An analysis of the ore is as follows: As, 18.75 per cent; Co, 1.80; Ni, 6.26; and Bi, 4.40. The orebody was lost at a depth of 60 meters and the mine abandoned.

ARQUEROS

Arqueros was located near Coquimbo, and is chiefly interesting from the fact that a native silver amalgam was found as amygdules in andesitic lava, from which a considerable quantity of metal was produced.

OTHER SILVER MINES

In addition to those previously mentioned there were numerous other silver mines, such as Garin Nuevo, Garin Viejo, Checo de Plata, Bandurrias, Cifuncho, Esperanza, Huantajaya, Descubridora de San Felipe, and Putaendo, to mention only a few, some of which were important producers.

Lead Deposits

The paucity of lead veins in Chile, when one considers the profusion of copper and silver deposits, is rather surprising. The usual lead-silver or lead-silver-gold veins which one is accustomed to associate with nearly all mining countries do not exist in Chile, or if they exist they have not as yet been discovered and worked. There are, however, a few small veins from which is mined and sorted a galena product carrying low values in silver, but the tonnage of this material is very small. The deposits appear to be the merest vein roots, are very narrow, and all mineral completely disappears at a few meters' depth. In all cases which I have seen the galena is in close association with copper minerals. In one rare case a small lens of rich free gold was encountered in one of these veins. One specimen of it I saw, and that a remarkable one—a mass of malachite as large as one's fist, literally permeated with wires of gold as large as a tenpenny nail, and the larger rods closely faced with smaller ones, the mass running about 25 per cent free gold.

Practically all the copper-lead veins are found on the western slope of the Caballo Muerto range, as narrow fissures in the Caballo andesite. The maximum width of any vein which I have seen is about 30 cm. Owing to the high price of lead during the last few years, a small production has been made from some of these, but the aggregate would not be over 500 tons.

In the Copiapo country, in line with abandoned silver mines, are some interesting mineralized dikes, carrying an interesting series of minerals. These dikes belong to the Caballo series, and were intruded in tension cracks along the trough of the former low and flat syncline which (now uplifted) forms the eastern side of the Copiapo River. After their intrusion, the dikes were again fractured and mineralized with galena, deposited in veinlets in the fractures. Then followed a much later mineralization of chalcopyrite. A small amount of gold and silver accompanied the galena.

Of these veins the surface has been eroded down considerably and oxidation has proceeded to a depth of about 30 meters only. Samples across such dikes give an average of 3 per cent lead, 2¼ per cent copper, 60

grams of silver, and about ½ gram of gold. The values in copper have been somewhat increased by secondary processes.

There are a large number of such mineralized dikes, and the mineral content varies considerably from one to another. Also, a number of years ago, I noted in a much sericitized Caballo dike, in the Caballo Mountains, small specks of galena about the size of a pinhead. A sample of this material assayed 36 grams of gold per ton. It is not impossible that some of these mineralized dikes may at some future day be developed into mines.

There are in other parts of the country, scattered through both the high Cordillera and the lower coast range, here and there, small veins of galena, none of which as yet have amounted to anything.

Gold

Before the days of silver mining—that is, before 1850—in the region of Copiapo, around the mountain Jesus Maria, several gold-quartz-copper veins were worked. Ancient rumor has it that some bodies of rich ore were extracted. The workings attained a depth of 300 meters or so in a few cases, but all those mines have been abandoned for many years.

The Cuba district was extensively worked by the Incas before the Spanish conquest in 1540; and in modern times has produced considerable gold combined with copper. At present the entire production from there does not amount to ten tons of ore per day.

In prehistoric times the Indians worked extensively small chalcedonic lenses in the Antigua granite, and in the Intruso granite, for gold. Thousands of such small workings are still to be seen. I had assayed several samples from such workings, and the maximum assay given was 3 grams of gold per ton. This is probably about the grade of ore that the Indians were able to work profitably.

In spite of the many workings which were being operated at the time of the arrival of the Spaniards, history records that the Indians had very little gold. Of course it is possible that they had sent previously what they had to the ruling Incas in Cuzco by way of tribute, since those kings ruled over this land and probably collected taxes and tribute in some form or other. Be that as it may, there is no evidence to prove that any large amount of gold was ever produced by the workings in this country.

In the south, in the region of Valparaiso, there were a few low-grade placer deposits, and efforts have been made in late years to work them. At Cogoti and Malga-Malga gold has been found in small quantity, as a residual from granite erosion, and some has been recovered. In the Andacollo region near Coquimbo, also, small placers have been worked.

A few small veins such as Las Vacas north of Valparaiso are still being worked, but no large profits have been made.

Iron Deposits

A large number of iron deposits are scattered along and throughout the coast range of Chile from one end of the country to the other. Some of these are large and of high grade. Of these there are two types, those of igneous or magmatic origin and those of sedimentary or hot-spring deposition. The igneous deposits generally occur in veins up to 10 meters in width; and associated with the hematite is usually crystalline calcite in masses or in veins. Generally in the veins the hematite is dark-colored and specular; often it is accompanied with various amounts of copper, in which case the copper is a later mineralization. In fact, this mineralization of calcite, hematite, and copper runs the entire gamut of mixture which characterizes the three constituents. The calcite, however, always occurs in the upper portion of the vein and soon gives way to hematite, and that in turn sometimes gives way to quartz in depth; so that from the top to the bottom of an ideal vein the sequences would be at the surface, pure calcite, shading with depth into pure hematite, and then in turn giving place to quartz. The zones overlap to a certain extent, and so far as I know no single vein has ever been worked through the three zones. Separate veins, however, display the three characteristics. Throughout the entire country, specular hematite and magnetite are common and abundant gangue minerals in copper veins.

The sedimentary hot-spring deposits are of different

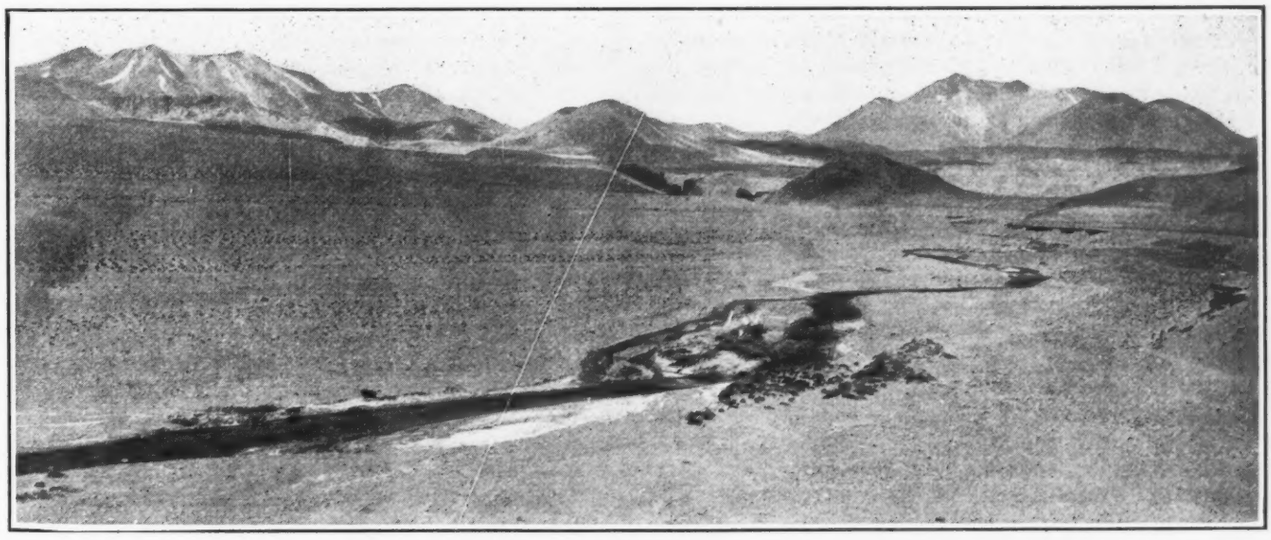


Fig. 7—Mount Piedra Parada on left and Mount Juncal on right

These two peaks are not directly on the Blanco fault, but on a crossing fault, which extends between the Blanco and Frontera faults. They are examples of completely developed volcanos, which are found in many places along the range. The altitude of the highest point on Mount Piedra Parada is 6,115 meters (20,054 ft.).

nature. In these the hematite is red, and specular hematite is practically absent, but it does occur occasionally. Some of these deposits are large. Generally they are found adjacent to the deposits of Travertina limestone, but sometimes this formation is completely lacking. Also, there are deposits of Travertina near which hematite is completely lacking.

In general geologists working on these iron deposits have failed completely to recognize the two types, and from that failure much confusion has resulted. In the accompanying table is an analysis of the two types of ores.

	Igneous Origin, Per Cent	Sedimentary Origin, Per Cent
SiO_2	12.52	2.20
CaO	6.54	0.50
MgO	0.30	0.20
Al_2O_3	1.28	0.85
Fe	46.28	67.00
P_2O_5	0.60	0.16
Co	0.00	0.00
Ni	0.23	0.00
Mo, Va, As	tr	0.00

It would be indeed difficult to enumerate the list of these deposits, which are to be found throughout the Coast Range, but the number must be several hundred. Along the strike of the Pueblo Hundido formation, in the Chañaral drainage area alone, there are about fifteen; and all along the Coast Range, on the eastern slope, where the hot springs broke out as a result of dying volcanic activity, is the favorite habitat of these iron deposits. One deposit, the Tofo, near Coquimbo, is being worked by the Bethlehem Steel Co., and from it the company is shipping to the United States, to be smelted, about 1,250,000 tons of ore per year.

Sulphur Deposits

Almost every volcano along the main Andes range, which through various stages of eruption came to the extrusion of the Salitre tuff with its accompanying Blanco rhyolite, contains a sulphur deposit of varying size and richness. Some of these consist of the merest veinlets, scattered here and there around the borders of the rhyolite plug; and some make large, rich deposits such as is being worked at Ollague, near the Bolivian border. All of these deposits owing their genesis to solfataric action are found within the extinct craters, and even though large or rich are of little economic importance, on account of unfavorable geography and bad working conditions. They generally occur at altitudes of from 5,500 to 6,500 meters, where, on account of the bitter cold, inclement weather, and lack of oxygen, it is almost impossible to maintain workmen and completely impossible for these to accomplish any amount of work. In addition to bad working conditions the deposits are located so far back in the mountains, where there are no roads other than animal trails, that getting the material to railroad or port after it is mined is exceedingly expensive. In fact, sulphur can be placed in any port in Chile more cheaply from the Texas and Louisiana fields than it can be placed in the same ports from the deposits in the country only 250 km. away from the ports. In view of this, the Chilean Government levies a protective tariff of about $6 per ton, and by the aid of this artificial stimulant the local industry is worked to the extent of supplying the country's needs.

In such fumarolic deposits, sulphur seems to possess the power of atomic attraction to a high degree. Local surface concentrations are affected to a marked extent. Over pregnant "caliche," running say 9 per cent S, there will be a much enriched surface shell. This shell may assay as high as 85 per cent sulphur and will seldom be over a few centimeters thick. Oftentimes, also, where a gulch within a breached crater heads up with several branches into the outer rim of the Blanco rhyolite plug which is rich in sulphur, the flowage resulting therefrom will cause a concentration in the main gulch, to an extent that makes a workable body of sulphur. From such as this the local production is being maintained at Ollague. Both of the extinct volcanoes shown in Fig. 7 contain deposits of this type.

There are in the country a few deposits of another type, certainly coming from the same volcanic source, but located far from the original craters. These deposits are found in several places, but notably about 80 km. north of Pedernales Salar. Such deposits lie on the flatter plains, in all cases on a flow line from some crater. They are tabular in shape and rest on gravel. In thickness they run up to two meters; in horizontal extent they may be roughly 150 by 50 meters; and they carry from 85 per cent to 95 per cent sulphur. The sulphur is bedded in well-demarked planes. Much of it looks as if it had been melted; occasionally there are inclusions of sand and dirt, but in general the entire mass is very pure sulphur. Whether the sulphur found under such conditions flowed out with the volcanic mudflows and segregated within them, or whether it flowed out sublimated from the craters to its present location, I have no idea. In fact, I am at a complete loss to account for the method of migration of such large quantities of sulphur to a distance of as much as 30 km. from its original source. At some future time possibly these various deposits may be of economic importance, but at present they have no possible chance of competition with other and cheaply worked deposits such as in Japan or in the United States.

An Uncommon Manganese Deposit

The presence of manganese minerals on the eastern and southern borders of the Olympic Mountains, Washington, was known as early as 1912, when they were recognized in some copper prospects, but their possible value as a source of manganese only became evident during the World War. Attempts were made to work the deposits, but were unsuccessful because the only materials that could be found contained too much silica to permit their conversion into alloys of acceptable grade. These deposits, which are known to be large, may yet become an important resource if the silica can be eliminated.

Since the war, however, prospecting along the north slope of the mountains has led to the discovery of several deposits, one of which near Lake Crescent has yielded in three years about 17,000 tons of ore containing more than 52 per cent of manganese and less than 9 per cent of silica, probably the largest concentrated body of this grade that has yet been found in the United States. Further prospecting has shown that there are other deposits on the southwest side of the mountains. Bulletin 795-A—"Manganese-Bearing Deposits Near Lake Crescent and Humptulips, Washington," a report of a preliminary study of all these deposits by a geologist of the Geological Survey, Department of the Interior—shows that although the mineral composition varies from place to place, the deposits all lie at nearly the same stratigraphic position in the rock section, and the hope is held out that more deposits of high-grade ore may be discovered in the same belt.

Flotation of a Gold Ore in a Cyanide Solution

At the Independence Mill of the Portland Gold Mining Co. at Victor, Colorado

By J. M. Tippett
Manager, Portland Gold Mining Co.

SINCE the rich ores of the Cripple Creek district were first discovered in 1892, numerous processes have been developed and many great reduction plants have been built for the treatment of these ores. Soon after discovery, production from these deposits became so great that the smelters of the state were unable to receive it, mainly because of its high silica content. Hurried efforts were made to treat the ores by hydrometallurgical methods. Stamps and amalgamation were first tried; next, gravity concentration; later cyanide leaching; and then came a long period of barrel chlorination, during which many large chlorination plants were built. Following the use of the chlorination process, the method of treatment changed back to cyanidation. Development of methods of treatment for these ores has passed through a long period of experimentation, involving the expenditure of hundreds of thousands of dollars.

John M. Tippett

The expensive operation of roasting, preliminary to treatment, was invariably the predominating practice. In 1910 the Portland Gold Mining Co. decided to make an attempt to treat the low-grade ore without roasting. A 600-ton mill, commonly known as the Victor mill, using gravity concentration and cyanidation, was subsequently built. Concentrates were shipped for roasting to the company's Colorado Springs plant, known as the Portland mill, which was then in operation. The Victor mill was in many respects successful, owing to economic conditions, yet the metallurgy still required improvement, as evidenced by later developments. (Note: The Portland Gold Mining Co. has built five great reduction plants for the treatment of these ores.)

During 1918 the company tried out flotation on a large scale, but failed, and naturally so, for the reason that too much was expected of it in its application to these ores. The operation consisted of trying to obtain all the precious-metal values in a one-step operation. A water medium was used, resulting in a large amount of uncontrolled low-grade concentrate which still had to be roasted preliminary to cyanidation, and, also, the tailing from flotation was a little high in precious metal as compared to treatment with cyanide and table concentration.

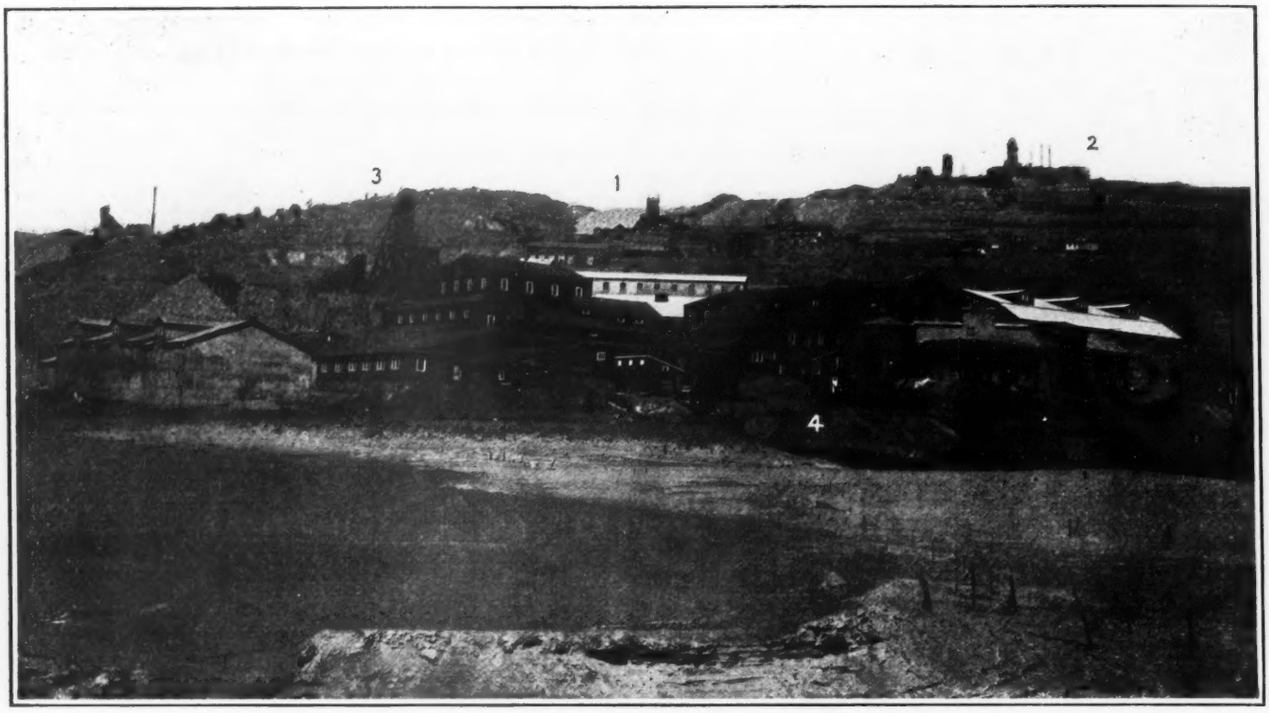
Discontinuing flotation, the company then built the present Independence mill for the purpose of treating a large tonnage of low-grade ore without roasting. Table concentration and cyanidation were used, the concentrates being subsequently shipped to some plant where they were roasted for further treatment. The thought of applying flotation to these ores in a different way was originated by myself in 1916 and 1917, when a patent (No. 1,236,501) was applied for, and granted. This patent covers flotation in a cyanide solution, and is mentioned merely for the reason that it describes closely our present large-scale operations consisting of a selective flotation in which the iron is dropped and the precious-metal values are floated. The idea was conceived from a study of the values in these ores, usually found in the seams and upon the faces of the rock. When the ore is broken or crushed the values concentrate in the fines, and, furthermore, the very nature of the mineral with which the values are associated—tellurium and sulpho-tellurides, naturally brittle—further encourages the values to seek the fines after crushing. In addition to the values above referred to, there is a certain value, naturally fine, associated with the talcs and clays. These values are usually combined with calcium, iron, sulphur, and tellurium. The latter combination is the most difficult to treat. Treatment of these ores by roasting followed by cyanidation, or treated in the raw state by table concentration and cyanidation, results in approximately 90 per cent of the value in the residue being found in the minus-200-mesh product. To illustrate, the following is a typical screen test made on a residue after treatment of the raw ore by concentration and cyanidation. The gold assay value of the residue was 64c. per ton.

Size	Per Cent Weight	Assay, Gold Per Ton, Ounces
Plus 65 mesh	10.4	.005
Plus 100 mesh	14.6	.01
Plus 150 mesh	11.1	.01
Plus 200 mesh	13.1	.02
Minus 200 mesh	50.8	.06

If the original value of this ore had been higher, in all probability the residue value would have been higher than $0.64 per ton, as the minus-200-mesh portion might have reached an assay value of .15 oz., or even .20 oz., per ton, the percentages on the meshes remaining the same. If flotation could be made to remove this fine, ready to float, non-treatable value, the remaining values might offer only slight resistance to cyanidation without prior roasting.

Flotation properly conducted in an alkaline cyanide solution removes these values efficiently, converting them into a small volume—less than 1 per cent of the total ore—necessarily rich in precious metal, while the tailing float that has any value—depending upon the grade of the ore—passes on and is treated in the usual way. Having now obtained a small amount of rich flotation concentrate, the problem confronting one is, how may the concentrate be treated? As before stated, roasting has been considered necessary—the treatment of these concentrates without roasting will be discussed later. Our present large-scale operation using flotation in a cyanide solution, is as follows:

The ore is comminuted to 30 mesh in Chilean and



Property of the Portland Gold Mining Co. (1) No. 1 shaft; (2) No. 2 shaft; (3) Independence shaft; (4) Independence mill

ball mills in a cyanide solution, the strength of which is .25 lb. of cyanide and 1.00 lb. protective alkalinity per ton of solution, the latter being calculated on a CaO basis.

The flow passes to four 8-cell Ruth flotation machines —two sets of eight cells placed back to back—a total of thirty-two cells in all. This is a good arrangement, two 20-hp. motors, requiring only a small space, driving both double units. These machines have not given a moment's trouble since they were installed, and introduce sufficient air into the pulp in perfect diffusion, causing the precious-metal values to raise readily. An oil mixture consisting of only 90 per cent fuel oil and 10 per cent "Floto" pine is introduced at each of the five ball mills by means of a standard micrometer oil feed pump at the rate of from .2 to .4 lb. of the oil mixture per ton of ore. The flotation concentrate—approximately 1 per cent of the total ore—passes to a thickener, the overflow of which goes to a second thickener. Clear overflow from the second thickener passes into the mill circuit, the underflow receiving special treatment, which will be described later. Tailing from the flotation machines containing any value passes to Wilfley roughing tables. Tailing from the tables is sent to thickeners, the underflow of which goes to low-grade agitators. Concentrates from the roughing tables pass to finisher tables, the tailings or middlings from the latter tables going to ball mills, where they are re-ground and then classified in closed circuit with the ball mills—as is indicated in the flow sheet. The product overflowing the classifiers, of which 60 per cent is minus 200 mesh, then passes into the main mill flow going to the flotation cells. It perhaps is well to note here that these concentrates are now finer than they were when they first passed through the flotation cells. Flotation has removed some of the values, and the remainder of the sulphides, being finer, pass into the tailing from the roughing tables, and on to the low-grade agitators.

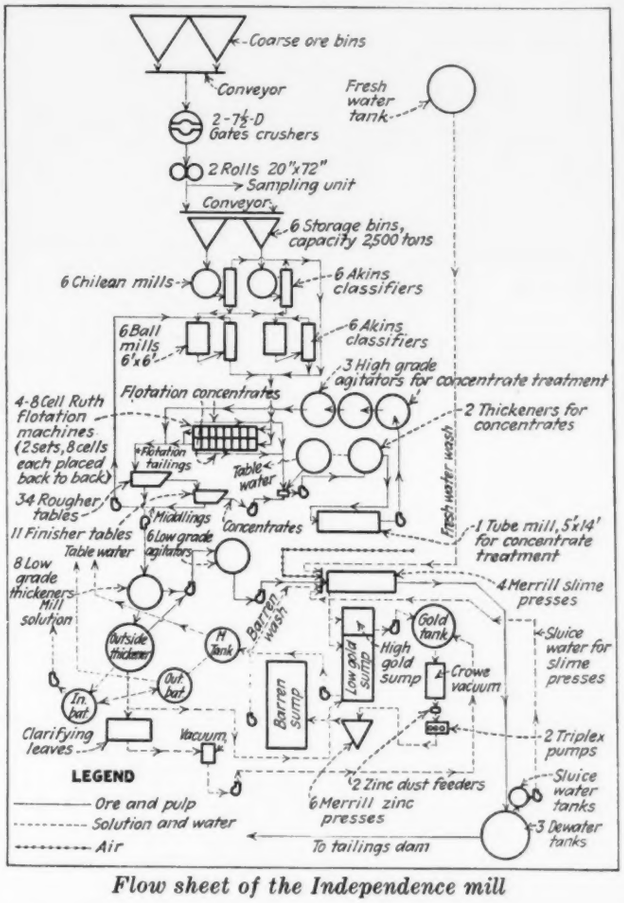
A small quantity of rich, coarse concentrate—less than 1 per cent—is taken out at the finishing tables and pumped into the thickener containing the flotation concentrates. We now have a small amount of both flotation and table concentrates mixed together, and, as previously stated, the problem confronting us is to devise a method to treat these concentrates without first roasting them. This step, in the present operations, is accomplished by introducing the underflow of the concentrate thickener directly into a reducing device. In our case a 5x14 ft. tube mill lined with hard iron liners, and loaded with —½ in. to 2 in. grinding balls is used. The concentrate is introduced in given quantity, or set charge. In our operation there is approximately one ton of concentrate to two tons of alkaline cyanide solution to the charge. The charge is sealed up, excluding all air, and the mill rotated for one and one-half hours, or longer if required. This results in finer grinding of the concentrates, together with the intensive reducing action on the metal particles.

In this preliminary treatment in the tube mill hydrogen is evolved, which helps break down the elements combined with the gold and silver which heretofore interfered with dissolution. The precious-metals particles are so conditioned that the subsequent treatment in a cyanide solution readily and efficiently dissolves the gold and silver. Upon this method of treating concentrates a patent has been applied for in the United States and in foreign countries.

After preliminary treatment in the mill, the charge is released into the high-grade agitating tanks (see flow sheet) and here treated from ten to twelve days in a 1-lb. cyanide solution, high in alkalinity, slacked lime being used. An intermittent operation as here detailed at the Independence mill, of 700 tons of ore per day, would seem at first glance to be rather out of line economically, but when it is recalled that the material treated is small in quantity as well as rich in precious metals—heretofore considered non-treatable without

preliminary roasting—it may be considered good practice.

The benefits derived from this treatment are: A residue twenty to thirty cents per ton lower in value for the same average value of ore; opportunity to treat higher-grade ore without increasing the residue; treatment of all our concentrates at a very low cost per ton; and an extraction of 96 to 98 per cent. The concentrates formerly were shipped at a considerable cost for freight and treatment, plus the surrender of all silver contained. Since flotation has been in operation—now more than two months—there has not been the least dis-



Flow sheet of the Independence mill

turbance in the cyanide circuit. The cyanide consumption remains the same, and the precipitation is excellent—in fact, even more perfect, since the flotation installation became operative.

Summing up the importance of this improvement, the method described permits the Portland Gold Mining Co. to treat its total production on the property, at a less cost per ton and with an increased extraction.

A New Artificial Abrasive of Corundum

Recently a special aluminous abrasive has been made in the electric furnace, using natural corundum in the place of bauxite, since the former has almost double its percentage of alumina. This new product when made into wheels is said to be superior to the bauxite material for certain classes of grinding and is now made in several United States abrasive plants. This use for corundum is gaining favor, and it is believed that about 1,000 tons annually is the present rate of consumption. The corundum must be very pure and as free as possible from titanium.

Discussion

Treating Low-Grade Manganese Ores

THE EDITOR:

Sir—We should like to enter the discussion on the manganese tariff by telling of our efforts, during the last three and a half years, to develop a process that will concentrate the low-grade ores of the United States. After almost two years in careful laboratory experiment we built, at the Mines Experiment Station here at the University of Minnesota, a 10-ton pilot mill plant. This plant has been in almost continuous operation since June, 1926. We are just completing a successful demonstration of the process.

The ores which we have run through the plant have come from the Cuyuna range, Minnesota, and are known as the "high-silica, black ores." These contain approximately 15 per cent manganese, 30 per cent silica, and 30 per cent iron. Our concentrate, in the form of sinter, contains from 66 to 71 per cent manganese and we are safe in saying that we can regularly make a product that will be 95 per cent manganese oxide. We have also treated ores from Cuba, Virginia, Arizona, Montana, and Nevada with equal success.

The small amount of publicity that has been given to our efforts has brought to us many manganese miners from the United States, and judging by their interest in what they see here this process will be in operation at a good many points if the tariff is not lowered. We expect the process will be in commercial operation within the next year provided the tariff question is not held open too long, so as to delay our plans.

The manganese miner does need protection in the form of a tariff, just as many other American industries need protection against the low costs of foreign countries.

BRADLEY-FITCH COMPANY,
Wilson Bradley, President.
University of Minnesota, Minneapolis, Minn.

Another Plea for Retaining the Tariff on Manganese

THE EDITOR:

Sir—A reduction of 50 per cent in the tariff on manganese would mean the shutting down of all manganese mines in Arkansas and probably all of the manganese producers in the United States. The fact that during the World War, in the first ten months of 1918, the production of domestic manganese was 50 per cent of the entire consumption in the United States for the same period should be proof that we have the manganese in the United States, if we can get a price to justify the production of it. In Arkansas alone one company has just made an investment of over $100,000 and has completed a large manganese concentrator. When this goes into operation, it will more than treble the present output in that state.

It is my opinion that the Tariff Commission has had the anti-tariff side of this question presented to it in an exaggerated form. The manganese producers have not been financially able to present properly the argument in favor of the tariff.

I have been engaged in manganese mining in Arkansas since 1887. My profits are very small and I

positively will have to shut down if the tariff is reduced.

The average wage paid to manganese miners in Arkansas is less than $2.50 per day. Producers who employ these miners in no instance have been able to pay in excess of 6 per cent dividends and quite a number earn no dividends at all. Their managers' salaries are also low. I cannot conceive why the Tariff Commission should wish to reduce the tariff unless it wishes to stop the industry and shut it down completely.

Taking the amount of manganese ore and manganese metal consumed in the United States as a whole between the years 1913 and 1918, inclusive, and dividing that into the number of tons of steel produced in the United States during the same period, we arrive at 14.7 lb. of manganese to the ton of steel. The present tariff of 1c. per pound of manganese in the ore should increase the average price of a ton of steel 14.7c. and would increase the price of 100 lb. of steel less than three-quarters of one cent.

Personally my opinion is that the steel corporations and consumers of manganese ore are not strenuously objecting to the present tariff. If this tariff is reduced, it will principally benefit one corporation which has invested good American money in Bolshevik Russia, hoping to reap 500 to 1,000 per cent profits. Just why American labor engaged in manganese mining should be pauperized to enrich any corporation, and also to help out the pauper labor of some foreign country, is a question I cannot answer from an American standpoint of equity and justice. I cannot believe that the President will reduce the manganese tariff at this time. I feel sure that he will not reduce it if he has all of the facts before him as they exist, for his Administration has shown him to be fair, and a reduction would be an unjust act against honest American workmen.

WALTER H. DENISON.

Cushman, Ark.

The Manganese Tariff

THE EDITOR:

Sir—As a manganese producer, I thank you for coming out for the manganese tariff. Naturally, we are not arguing that the manganese question is not a question of military importance for the country. We think it is; but we think if we had a war now our generals would not surrender to the enemy if we had no 50 per cent ore on hand. Germany got along on old slags, and we have slags, and Cuyuna ore that will make a manganese slag. We think it a peace-time and a war-time advantage to the country to have our manganese industry developed, but do not think there is any situation of real alarm.

It is a fairer and truer conclusion, that some want a tariff and some do not, than that the interested parties are suddenly aroused to great heights of patriotism. Your logic on the question is good, and there is further logic that would confirm yours.

It is a piece of perfect nonsense to claim, in a way, that the United States was sifted, to get out the manganese, when it was created. If you will look up Clarke's Geochemistry, you will find that manganese is vastly more abundant than copper, lead, and zinc combined. Anybody who knows anything about the chemistry of dirt will know how much manganese ore there is, if you took the same grade as you take for these other metals, and let the chemists have the said dirt. Manganese can be leached out of dirt easier and cheaper than any other metal, as SO_2 does it so easily.

The country is on the eve of having a manganese industry, and certain foreign mine proprietors seem to have awakened to the fact, and got busy.

West Cummington, Mass. ANSON G. BETTS.

An Organization to Study Hydraulic Mining

THE EDITOR:

Sir—In the June 25 issue Mr. P. Bouery has stated that the hydraulic miners of California need organization for the purpose of making their case known. He asks, "Who are the organizations willing to make a study of this problem?"

As chairman of the section on mineral resources of the Commonwealth Club of California it is a pleasure for me to inform Mr. Bouery and all others interested in this matter that an impartial study of this subject from the standpoint of the agriculturist, the irrigation engineer, the power interests, the navigator, and the miner is planned as an important part of the next twelve months' work of our section. It is trusted that a report will result before the next session of the California Legislature.

The Commonwealth Club of California is an organization formed for considering subjects of interest to the commonwealth and from an impartial standpoint. Its section on mineral resources will be pleased to have the benefit of the knowledge as well as the co-operation of such men as Mr. Bouery and others who are well informed and interested in this matter from various standpoints.

WALTER STALDER.

San Francisco.

The Missouri School of Mines Antedates Colorado

THE EDITOR:

Sir—In your editorial in the July 9 issue on "The Colorado School of Mines" you state that it was "established officially by territorial legislation in 1874, so that it is junior in age only to the Columbia School of Mines."

The Missouri School of Mines opened its doors in 1871 and graduated Gustavus A. Duncan, John H. Gill, and John W. Pack in 1874. By 1883, when the Colorado School of Mines conferred its first degrees, the Missouri School of Mines had thirty graduates, probably the most well known being Walter W. Wishon.

Borger, Tex. DONALD R. BAKER.

Favors Protection for Manganese

THE EDITOR:

Sir—I am and have been a constant reader of the *Engineering and Mining Journal* for many years. I write to endorse and compliment your stand upon the subject of a tariff on manganese. Your splendid editorials and the several articles you have published from contributors present the subject in a splendid manner, which should be effective. The courageous manner in which you present to the public the source of the proposal to abolish the tariff is also appreciated by those familiar with the manganese situation in the Pacific Northwest.

Seattle, Wash. MAURICE D. LEEHEY.

News of the Week

Summary

INCREASE IN DUTY on fluorspar seems likely to be recommended in view of testimony submitted at the Tariff Commission's hearing on July 22-23. Maximum increase of 50 per cent may not be found warranted.

Representative of Bethlehem Steel Co., at fluorspar hearing, urges that no increase in duty be allowed, on the ground that it would be unfair to Atlantic Coast steel manufacturers who must continue to use foreign fluorspar and at the same time sell steel in competition with foreign producers.

New clinic in the Joplin-Miami district examines 815 persons since April. Latest X-ray and laboratory equipment is being installed in new clinic building.

Gold discovery at Parsons, W. Va., said to be drawing inhabitants of Roanoke and of the southwest section of Virginia.

Group of speculators in London are said to be attempting to corner spot tin.

New government mining engineer's report on the probable life of the Witwatersrand gold-mining industry is discussed by the Rand members of the House of Assembly.

Many new alluvial diamond mining companies are formed in South Africa as a result of the precious stone bill meeting with unfavorable action in the Senate. This action means that the diamond syndicate will have to absorb more alluvial stones and to reduce still further the production of the "Big Four."

Smithsonian Institution sends paleontologists on expedition to the Northwest Rockies to complete stratigraphical work begun by Dr. Charles D. Walcott.

Two parallel reefs of amethyst are discovered near the Yokeskei River bridge on the main road from Johannesburg to Pretoria.

Fire at the Quincy mine, in the Michigan copper district, is believed to be about out.

Record Year Predicted for Kirkland Lake

Production of District at New High Figure—Teck-Hughes Property in Lead—Deep Development Disclosing Important Orebodies

By E. G. Wilson
Special Ottawa Correspondent

A STORY of steady progress is clearly revealed in the latest facts and figures relating to the development of the Kirkland Lake mining district of northern Ontario. Production in that district last year amounted to $7,193,393. Present indications are that before the end of 1928 the combined output of the camp will most probably exceed $20,000,000. A substantial increase was registered in May of the current year, when the district's production reached $1,857,632. This is the largest Kirkland output on record and is chiefly to be credited to the Teck-Hughes property, which now leads all the Kirkland mines. Deep development in the district is disclosing higher gold values and larger orebodies. It is estimated that many millions of dollars of new wealth will come from Teck-Hughes, Lake Shore, and Wright-Hargreaves mines alone.

Ontario gold production figures for 1926 show that Kirkland Lake was largely responsible for the slight increase over the record of the previous year. The output in 1926 was $31,099,000. Porcupine showed a decline of $900,000 to $23,680,000, while Kirkland Lake showed an increase of $1,800,000 to $7,193,000. The latter was attributable to general expansion of operations in the camp, and the Porcupine loss was caused by the decline in Hollinger output, which fell off to $14,829,000 from $15,749,000. Although gold has been mined and milled in Kirkland Lake since 1913, it was not until 1920 that production reached the million-dollar mark. Since that time there has been a steady increase from year to year.

Lake Shore, the largest producer in Kirkland Lake last year, started production in 1918, when a total output of $416,414 in gold was obtained. The output in 1926 reached a total of $2,775,000. For the last quarter of the year, production amounted to $780,000. The mill was then handling an average of 565 tons of ore daily, of an average grade of $15.34 per ton. At present it is treating approximately 625 tons of ore daily of a similar grade, and producing gold at a rate of about $3,500,000 annually. Lake Shore recently completed the sinking of the main shaft to the 1,600 ft. level.

The second largest producer in the Kirkland Lake camp last year, Wright-Hargreaves, had its first production in 1913, amounting to $1,127. No more gold came from the mine until 1921, when the output amounted to

Main Street, Kirkland Lake, Ontario, Canada

$468,751. This has climbed steadily year by year until a total of $2,150,844 was produced last year. Underground development at this mine has recently been considerably increased. The twenty-five rock drills now in use are approximately double the number at work three months ago. The property is close to 4,000 ft. in length, and well situated in the main zone of mineralization. At one end of the property is the Lake Shore mine; on the other is the Sylvanite. Development has reached a depth of 1,500 ft. in two shafts. Hoisting equipment for twice this depth has been installed.

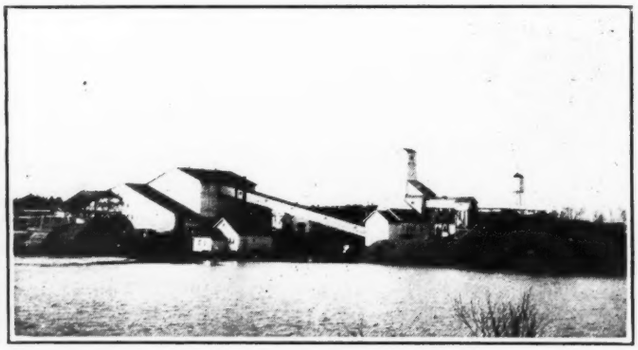
Teck-Hughes occupied third place on the list in 1926. Production was started ten years ago and has climbed steadily, being $1,601,209 last year. The mine has now the second deepest workings in the camp. In a short time the shaft will reach a depth of 2,250 ft. Six new levels are being opened up below the 13 level. Rich ore is being encountered over good widths in the shaft-sinking operations.

Another mine which is making a good showing is Tough-Oakes Burnside. For many years this property experienced reverses, but production has climbed steadily since 1923, amounting to $309,709 in 1926. Exploration is being carried out on many levels down to 1,300 ft., and the sub-shaft is being sunk to 1,600 ft. in the hope of developing more consistent oreshoots at this depth and finding ore east of a diabase dike, which evidently has a definite bearing on the ore deposition of the Kirkland Lake camp.

Kirkland Lake Gold mine is the deepest in the camp. Operations are now under way on the 2,475 level, and it is reported that commercial ore has been opened up at this point west of the shaft. The milling plant was started late last summer, resulting in a production last year of $126,999. This brought the total output of the mine to date to $1,206,590.

The Township of Munro, a short distance north of Kirkland Lake camp, made mining history a few years ago, when nearly a million dollars' worth of gold was taken out of the Croesus mine in shaft sinking and pure development work. Present indications are that history will repeat itself. The present Munro activity has resulted from the discoveries made on the Potter-Doal, Kingston-McRae, and Warden properties, all staked by Messrs. Potter and Doal, who are well known in the North Country, and who have staked or grubstaked many of its discoveries.

Many other important mines in the district are repidly coming to the front as producers, and quite a few are also carrying out preliminary development work which looks promising. It will be surprising if a number of new gold producers are not developed in this area during the next few years.



Kirkland Lake Gold Mines

Main shaft on Sylvanite property of Sylvanite Gold Mines, Ltd.

Surface plant at Wright-Hargreaves mine of Wright-Hargreaves, Ltd.

Lake Shore property in the Kirkland Lake district, Ontario. T. & N. O. Ry. spur to new shaft is shown on the left

Smithsonian Paleontologists Leave for the Rockies

To complete the unfinished work of Dr. Charles D. Walcott, late secretary of the Smithsonian Institution, on the stratigraphy of the Rockies, a motor-truck expedition to the mountainous Northwest has been dispatched from the Institution. The expedition is under Dr. R. S. Bassler and Dr. Charles E. Resser. Its first destination is Utah, whence it will work up through Montana to British Columbia.

Dr. Walcott was the foremost authority on the Cambrian. He first proved by the discovery of certain fossils in the older Cambrian rocks that life had existed in that geological era much earlier than had previously been believed. For years before his death last February he had been devoting every summer to extended trips in the Canadian Rockies, working out the order in which the rocks had been laid down in geologic time. At his death he left a large manuscript containing the result of his work. It lacked certain details which he had hoped to secure this summer. In an effort to secure early publication of this important manuscript, the Smithsonian is sending out the expedition to collect the missing data.

California Mining Notes

Satisfactory progress is reported in the development and operation of the Supply mine of the Arrowhead Development Co. in the Dale district, San Bernardino County. Drifting is being carried on both north and south on the 100 level of the Jean shaft, gold ore from three to eight feet in width being opened up.

Sinking operations in the main vertical shaft of the Kennedy mine, at Jackson, Amador County, last week reached a depth of 4,764 ft., making it the deepest gold-mine shaft on the North American continent. Driving of the new lower levels will be started at once. A tube mill is being added to the mill equipment, for regrinding the coarser sand. The Kennedy mill is crushing 300 tons daily.

Speaking of the appropriateness of names, a Redding dispatch records that Thomas R. Towle, of Paradise, has located a mining claim on Whiskey Creek, in the Whiskey Creek mining district, a mile and a half from Whiskeytown, which he has named "Bootleg."

Fire About Out at Quincy Mine, in Michigan Copper District

Future of Seneca Property Cause of Speculation—Copper Range Mines Being Vigorously Developed

The situation at the Quincy mine, in the Michigan copper district, where a fire is burning in No. 2 shaft in the vicinity of the 53 level, is improving steadily. The opinion is expressed by the management that the fire is about out and that it is a matter of days only until it will be safe to reopen the mine for a thorough investigation. Nos. 2 and 6 shafts and connecting openings have been sealed since the fire broke out, but conditions in No. 2 are tested daily. The crew of a U. S. Bureau of Mines rescue car, now at the mine, is assisting in this work. The data obtained show a decided decrease in temperature and favorable gas conditions. This is the basis for the belief that the fire is burning itself out.

No. 2 shaft is the richest in its history now. Its bottom levels are in exceptional copper values. The new East lode, which has been again encountered in a chute winze from the 89, or bottom, level, is particularly rich in heavy copper. It has steadily improved with depth and the lode is wide and strong. The Main Pewabic also continues consistently mineralized in the deepest levels. The new East lode will be a rich source of copper when it is sufficiently opened to permit regular stoping. For this reason No. 2 shaft will be put in condition again regardless of the extent of the fire damage. At present the damage is not believed to be large.

Pumps are in operation at the Seneca mine, recently closed, to keep the shafts dry and in good condition. There is considerable speculation in the district as to the future of this mine. No plans for new financing have been announced. It is the belief in mining circles that either Calumet & Hecla Consolidated, or Mohawk, which have adjoining properties, could make Seneca a profitable mine. Calumet & Hecla, with its own railroad, stamp mills, and smelter, and which has cheap power, could effect notable economies in development, mining, transportation, crushing, and smelting, as well as in fuel and supplies. Mohawk also has favorable advantages, having its own railroad right-of-way and reasonable haulage charges, stamp mill, and a large interest in the Michigan Smelting Co.

At the Copper Range group of mines, the most vigorous development policy in years is in progress. As a result, the amount of stoping ground in reserve is well in advance of requirements. Although the average yield of copper per ton of rock from the Champion Baltic and Trimountain has fallen off somewhat, this group promises to hold its position as the richest of the amygdaloid producers. Since 1918 the yield has not fallen below 36 lb. of refined copper per ton of rock treated. In Champion, new ground in No. 4 shaft, although of fair quality, is not up to that of former years, but in No. 3 openings to the south show considerable improvement. In No. 1 shaft improvement also is noted in the bottom levels. In Baltic, openings in new ground are in rock of good quality. Copper Range cannot hope for values in territory beyond the fault at the south end of the mine. Explorations toward the old Globe property have shown this to be a crushed and barren zone. Drifts from the upper levels and from the 18 level were extended as far as the Globe boundary, without results.

Installation of the electric hoist at the 78 level of No. 4 Calumet shaft of Calumet & Hecla Consolidated has been completed. It will be used to hoist rock to the main haulage level, through which it will be transported to the Red Jacket shaft. No. 4 is bottomed at the 93 level. The hoist will not go into commission until the shaft is drained in the bottom levels. Considerable water remains to be pumped. No. 4 will be the only shaft at the Calumet end of the conglomerate department to operate below the haulage level. The electric hoist at the 80 level of No. 7 shaft, Hecla branch, is in operation. In the North Kearsarge No. 1 shaft, the long drift to the south on the 40 level is in good ground on the Kearsarge lode. Work in this opening, now in 2,700 ft., which is being driven under Wolverine toward Centennial, will be speeded up. Three shifts instead of two will be employed. Drifts to the north in this shaft opened rather disappointing ground. Only one stretch of 1,000 ft., on the 35 level, opened rock that may be profitably stoped from No. 4 Ahmeek shaft later when a higher price for copper prevails.

Ahmeek, of Calumet & Hecla Consolidated, is the chief producing unit in the district, yielding more refined copper than any other branch of the company and more than any of the other district producers. The Kearsarge branch of Calumet & Hecla Consolidated produced about 36 per cent of the company's 1926 product, or better than any average of 3,000,000 lb. per month. Ahmeek openings are kept well in advance of requirements, and, although the grade of rock uncovered in new territory is somewhat below the average in copper content, it will continue to be a rich mine for many years. Its yield per ton of rock treated should continue at well over 30 lb. of refined copper per ton.

Sept. 5, 6, and 7 have been definitely selected as the dates for the pilgrimage of the Michigan Engineering Conference to the Michigan copper district, according to word received by W. O. Hotchkiss, president of the Michigan College of Mining and Technology, who is a member of the state committee. The society is coming to the district upon the invitation of president Hotchkiss, who addressed the members at their annual meeting last winter.

Uvallama Mine Changes From Cyanide to Flotation

The Kinne Hill Mining & Milling Co., operating the Uvallama mine, in Sonora, Mexico, has taken over the adjoining La Colorada and Jazmine claims. Flotation equipment is being installed at the Uvallama property, as the cyanide process previously used has been abandoned. A. C. Overpeck, of Tucson, Ariz., is in charge of operations.

New Tri-State Clinic Examines 815 Persons Since April

Each Miner Given a Card Bearing His Physical Rating—Latest X-Ray Equipment Being Installed

One of the most interesting developments of the year in the Joplin-Miami district is the new Tri-State clinic, one of the largest in the United States. It is supported by the U. S. Bureau of Mines, the Metropolitan Life Insurance Co., and the mine operators of the district. Since April 781 men from 35 different mining companies operating in the field have been examined at the clinic. In addition, 34 women and miners not employed have been examined. Each miner examined is given a card on which his physical rating is recorded. A detailed explanation of these ratings was made to the mine safety engineers of the field at a meeting held at Picher on July 20, the explanation being given by Dr. F. V. Meriwether. Three doctors have been sent to the clinic by the Bureau of Mines, and another will be supplied. The clinic will continue to be in charge of Dr. Meriwether, assisted by Drs. J. W. Huff, O. W. Linhart, and Charles P. Waite, with O. E. Gilliland, technician. Latest X-ray and general laboratory equipment is being installed in the special building which has been built at Picher, Okla. It is estimated that it will cost $48,000 to operate the clinic the first year and $35,000 for succeeding years.

It is reasonably certain the operators of the Joplin-Miami mining field will support the proposal to change the present system of depletion allowances, based on "discovery" values, to one whereby a flat percentage of gross income will be the basis. The Tri-State Zinc and Lead Ore Producers' Association recently sent a committee of three, consisting of J. D. Conover, secretary, A. Scott Thompson, an attorney of Miami, Okla., and Wade Hurtz, an accountant of Joplin, Mo., to Washington to participate in a conference of engineers with the Congressional committee on taxation. Returned from this conference, the committee reported to the Ore Producers' Association on July 20, and the members, after hearing the report, authorized the committee to carry on negotiations with the Congressional committee in accordance with its convictions, which were reported as generally favorable to the proposed change.

Flotation plants are being installed in two properties in the Joplin-Miami field, one at the Crestline plant of the Andrew Mining Co. and one at the Independence mine, owned by H. J. Schmidt and associates, of Kansas City.

Patty C mine, consisting of a 156-acre lease and a 200-ton mill, has been sold by Roy Coyne to the Century Milling Co., owned by Wesley Smith and Floyd Meyers. The consideration was not made public. The mine was one of those owned by the late Thomas F. Coyne, and developed by him.

Half a dozen properties in the Joplin-Miami field that have been down for from two to eight weeks have been started up again, indicating that production will be increased in the period immediately ahead.

News From Washington

By PAUL WOOTON
Special Correspondent

Recommendations for Higher Duty on Fluorspar Expected

Possible That Maximum Increase of 50 Per Cent May Not Be Found Warranted

IN VIEW OF THE TESTIMONY submitted at the Tariff Commission's hearing on July 22 and 23, particularly when considered in conjunction with the commission's own findings as to production costs, it seems likely that an increase in the duty on fluorspar will be recommended. If it should be shown, however, that some of the items making up the domestic cost of production are too high, it is possible that the maximum increase of 50 per cent may not be found warranted.

The producers were represented at the hearing by George H. Jones, of Chicago, president of the Hillside Fluorspar Mines; R. C. Allen, vice-president of Oglebay Norton & Co., of Cleveland; B. E. Clement, of the Holly Fluorspar Co., of Marion, Ky.; James E. Green, of the Holly Fluorspar Co.; and C. W. Haynes, of the Independent Fluorspar Co. These producers approved the report made for the commission by Myron R. Walker, a mining engineer on its staff. The producers suggested that if reclassification for tariff purposes be considered advisable, not less than 98 per cent calcium fluoride and not more than 1 per cent of silica be regarded as the determinents of acid-grade fluorspar. It was pointed out that a small proportion of domestic production is suitable for acid purposes, so that increased protection for that grade is not vital to the domestic industry.

The producers testified, further, that domestic reserves are adequate to meet the demand for an indefinite period for metallurgical purposes. They contended that there is no substantial difference in the quality of the domestic and of the imported material. This was contested, however, by some of the consumers, who state that imports usually contain less calcium fluoride than does the domestic product.

It was testified, further, that 1925 was a representative year for the determination of domestic costs and that there has been no material increase or decrease since, although production was less in 1926 than in 1925. Producers agree that the degree of purity of fluorspar is the only practical basis which can be used for reclassification.

The witnesses in opposition to any increase in the present duty testified that most of the imports of fluorspar are used by one steel company operating on the Atlantic seaboard and that even were the maximum increase in duty ordered, that company would continue to use foreign fluorspar exclusively, because of the lower transportation cost incurred in the delivery of foreign metallurgical spar. C. A. Buck, vice-president of the Bethlehem Steel Corporation, urged that no increase in the duty be allowed, as it would be unfair to Atlantic Coast steel manufacturers, who must continue to use foreign fluorspar and at the same time have to sell steel in competition with foreign producers, who are sending more and more steel into the coastal region. He quoted the import figures to show the rapid rise in steel imports from 1901 to 1926. With the domestic producer already having great difficulty in meeting foreign competition, Mr. Buck held that he should not be further handicapped.

A representative of a large chemical manufacturing concern stated that 98 per cent calcium fluoride is too high a limit to place on acid-grade spar, because chemical manufacturers often purchase and use 97 per cent spar. He also stated that 1 per cent silica is the maximum amount allowable. The witness called attention to the fact that hydrofluoric acid is on the free list.

The present rate of duty, it was shown, does not prevent the entry of foreign fluorspar into the Pittsburgh market. In 1925 18 per cent of the amount consumed in the Pittsburgh district was imported. If the maximum increase in duty were allowed, it was stated that foreign material would be excluded from the territory west of a north and south line drawn through Buffalo.

Flotation grades of cresylic acid are not affected by the President's proclamation reducing the duty on refined cresylic acid. The grades used for flotation always have been on the free list.

Marshall W. Tuthill has been appointed technical expert in minerals in the office of the Secretary to supervise and co-ordinate the work of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce in the economics of minerals and metals, including collection, compilation, analysis, and dissemination of trade information relating to both foreign and domestic markets for mineral products.

On July 21 the Department of State received a telegram from the American consul at Chihuahua, Mexico, to the effect that an American citizen, Russell Johnson, superintendent of the mine of the American Smelting & Refining Co. near Parral, was kidnapped by bandits. The consul stated that federal soldiers were searching for the bandits. The department was informed in a later telegram from the American chargé d'affaires at Mexico City, that on July 20 he addressed an urgent note to the Mexican foreign office requesting that steps be taken at once to secure the release of Mr. Johnson and the punishment of his captors.

Cortez Stamp Mill at Tenabo, Nev., Changed to Flotation Plant

Red Hill Florence Mine Shut Down—Consolidation Proposed in the Quartz Mountain District

The ten-stamp mill of the Consolidated Cortez Silver Mines Co. at Tenabo (14 miles from Cortez), Lander County, Nev., has been converted into a flotation plant, and recently started operating on an eight-hour basis. A Marcy mill in closed circuit with a Dorr classifier follows the stamps, recovery being made in an eight-foot Parker flotation cell. A concentrate of good shipping grade is made without cleaning, and an excellent recovery is reported, although the deposit is an oxidized gold ore, with but few sulphides. It is planned to operate the mill on a sixteen-hour basis within a few days, and to go to continuous operation soon.

The Red Hill Florence Mining Co., which owns property in the southeast portion of the Tonopah district, south of, and adjoining, the Buckeye Belmont and the Rescue Eula companies, has discontinued work. Its development was conducted through the shaft of the Buckeye Belmont, on the 1,400 level. The principal heading was a south crosscut, which passed through the Buckeye Belmont property and the Red Hills ground, a total distance of 3,200 ft. Many small stringers were encountered, some of which contained good silver and gold values, but they were not of commercial size. The cost of operating the property was excessive for the reason that the mine workings were far from the shaft and natural ventilation. Also, there was considerable water with which to contend.

A new orebody has been encountered in a crosscut on the 350 level of the San Rafael mine, at Quartz Mountain, Nev. It appears to be a bedding-plane deposit in the hanging wall of the Lease vein, from which the principal production of the San Rafael has been made. The orebody, as exposed in the crosscut, is 17 ft. wide and averages $25 per ton. This ore contains more galena than is usually found in the San Rafael mine, where the ore is essentially a carbonate type.

It is planned to effect a consolidation of the four so-called Wingfield-Gordon-Thomas properties in the Quartz Mountain district—the San Rafael, Calico, San Felipe, and Exchequer. Details of the proposed consideration have not as yet been announced.

Diatomaceous Earth Mill Built

The crushing and screening plant of the Mount Shasta Silica Co., on the Pit River, Shasta County, Calif., is nearing completion, and is expected to be in operation by Aug. 15. It will have a capacity of 200 tons per day.

Gold Found at Parsons, W. Va.

Many persons from the Roanoke and southwest section of Virginia have left, or are planning to leave, for Parsons, W. Va., where gold in paying quantities has been discovered, according to advices from Roanoke.

Mexico City Letter

By W. L. Vail
Special Correspondent

Many Lead Producers Shut Down —Others Curtail—More Than 5,000 Miners Laid Off

Mexico City, July 17—The low price of lead has resulted in the closing of several properties in various districts of Mexico, and a curtailment of output with attendant reductions in operating forces at many other properties. The Real del Monte, Pachuca, advised the Department of Industry, Commerce, and Labor some time ago of the necessity of closing down a portion of its works, which action would mean the discharge of several hundred men. It is understood that an agreement has been reached between the management and government officials to pay the men 45 days' wages where men are let out because of the necessity of installing labor-saving machinery and two weeks' wages where discharge is the result of the impossibility of continuing work on account of the low price of metals, high cost of transportation, and kindred causes.

The mines of Santa Maria de la Paz, at Matehuala, San Luis Potosi, have also applied for permission to suspend operations pending a revival of prices, but, according to reports, the government was not disposed to concede permission and was considering taking over the properties and working them for account of the men. It was stated in a local paper that a large foreign company had offered to advance $800,000 for the purchase of modern machinery, and the government contended that by using modern methods the company would be able to continue work.

The latest property to close was the Compania Industria Unida de Guadalupe, near Zacatecas, throwing 1,000 men out of employment. The department, after a careful study of the situation, decided that the petition of the management to close, which was based on the fact that it had been running for a year at a heavy loss, was justified. Losses amounting to nearly 200,000 pesos from April, 1926, to April, 1927, and a loss of nearly 50,000 pesos in the month of April this year alone, were claimed. The closing of this property throws 696 miners out of work; also 27 Americans and 5 Mexicans otherwise employed.

It is estimated that over 5,000 miners have been discharged in the last sixty days and that the discharge of 15,000 more is likely if the petitions for closing now before the department meet with favorable action.

In their efforts to regulate the price of lead most of the lead-mining companies are reducing production and a number of smaller properties are temporarily suspending operations. The *Boletin*, of this city, states that the American Smelting & Refining Co. is making an 800 to 1,000 tons cut in its monthly production of lead, and that the Peñoles company is also making a heavy reduction. The various mining chambers of the country are calling upon the government for assistance in the form of reduced taxation and more favorable railway rates for transportation of metals. A government commission is making a study of the situation.

Efforts are being made to revive some of the old gold workings on the Pacific coast of Lower California. California capital has been furnished for the purpose. Options are out on a large deposit of magnesite not far from Magdalena Bay. The property is controlled by Americans; the proposed purchasers are Mexican industrial concerns, located at Monterey and Mexico City. These same deposits were worked extensively during the late war, and the entire output was sold in the United States. A tariff on imports of magnesite into the United States resulted in a cessation of operations. The same group controls large deposits of manganese on the peninsula, but no immediate attempts will be made to exploit the properties. Mining generally in Lower California, with the exception of the big copper and arsenic properties at Santa Rosalia, has been abandoned. After the new mining laws went into effect the prospector was obliged to quit.

The Department of Labor, Commerce, and Industry gives out the following figures as the result of mining operations in the republic for the first three months of this year: Gold production, 5,591 kilos; silver, 740,890 kilos; lead, 44,058,350 kilos; copper, 13,407,328 kilos; zinc, 24,930,885 kilos; mercury, 21,651 kilos; arsenic 1,273,426 kilos; graphite, 2,463,146 kilos.

These figures show an increase over the same period of 1926 of, silver, 4.52 per cent; copper, 27.07 per cent; zinc, 50 per cent; mercury, 158 per cent; arsenic, 4.49 per cent; and of graphite, 52.22 per cent. The gold production is a decrease of 9.41 per cent and lead a 14 per cent reduction. The decrease in gold output is ascribed to the working out of the El Oro camp, and the reduction of lead to the closing of several mines and the lower outputs of larger camps. The next three months will show a much heavier reduction in lead and a big falling off in zinc. In fact, mine operators see a considerable falling off in the figures for the entire year, owing to the generally unfavorable conditions existing and expected to exist for the next few months.

Alaska Mining Notes

The Cleary Hill Mines, Inc., has pumped out the shaft on its Bedrock Creek gold-quartz properties, and proposes sinking the shaft another 100 ft. to permit running a drift on the vein paralleling, on the 200-ft. level, the drift run on the vein for 700 ft. on the 100-ft. level. The company's properties include the Rhodes-Hall quartz mine, which produced gold to the value of about $1,000,000 prior to the shutdown due to war conditions. Another vein is being crosscut from the main tunnel. It is proposed to resume milling as soon as sufficient ore is in reserve from the current development operations. The Riley and Beaton dredges are being conditioned for the resumption of operations this season.

The Flume Dredge Co. will operate its dredges this summer on Little and Yankee creeks.

Calcutta Letter

By S. B. Banerjea
Special Correspondent

Proposal to Auction Burma Leases and Concessions Causes Anxiety

Calcutta, July 1—The Burma government recently addressed the Burma Chamber of Commerce on the subject of disposal of mining leases by auction or tender in the case of cancelled leases, and also on the question of extending the principle of auction to time-expired leases and new concessions. In the course of a lengthy reply the chamber has pointed out that if the government adopts this policy an appreciable increase in revenues is not likely to be derived; that the insecurity which lessees would experience would discourage them from working on sound and far-sighted lines; that a lessee who can render a good account of his work, at the end of his lease, is entitled to a renewal thereof; that though the government admits the rights of a "sitting" lessee to preferential treatment, when a new lease is under consideration, it offers no solution as to the method of giving such preference or to the extent to which the preference should be given; that the proposed policy would place small companies at the mercy of larger companies; that the suggestion that the state has the right to take advantage of and to sell the enhancement in value of a mining concession that accrues through the exertions of the lessee is unsound and is likely to discourage initiative; that the proposal to increase the scale of royalties, ground rent, and license fees is likely to check the inflow of capital for new development and exploration work. The chamber has sent a copy of its letter to the government of India, to associate chambers of India and Ceylon, and asked them to support its case. The government's decision is awaited with some anxiety by those affected by the proposals.

The Ooregum Gold Mining Co. of India, Ltd., has declared a dividend of 32½ per cent on preference and 22½ per cent on ordinary shares for the year ending 1926. Arthur Taylor, an official of the company, stated last year that the haulage facilities at the company's property in the Mysore district would not permit the previous scale of output to be maintained if the quantity of rock-filling mined were materially lowered. With numerous levels in good ore, very little waste rock is being broken underground and filling material must be sent down from the surface.

It is understood that the Indian Copper Corporation, Ltd., of London has just placed with Messrs. Fraser and Chalmers Engineering Works a comprehensive contract covering the manufacture of the complete plant for the Mosaboni mine and smelter in Chota Nagpur. The value of the contract is approximately $500,000.

According to the liquidator of the Burma Ruby Mines, the property of the company, as a result of recent development operations, has been converted into an excellent sapphire mine.

Johannesburg Letter

By John Watson
Special Correspondent

Dr. H. Pirow's Report Discussed With Interest by Rand House Members

Johannesburg, June 21—A report by the new government mining engineer, Dr. H. Pirow, on the probable future life of the Rand gold-mining industry, was presented to the House of Assembly early in June, and has been discussed with interest by Rand members. The present Minister of Mines stated recently that Dr. Pirow takes a more optimistic view of the future than did his immediate predecessor. Those who have studied the report closely say that no startling new information is disclosed, though Dr. Pirow draws attention to the promising development results obtained in the Sub Nigel and to the new policy of narrow stoping. He emphasizes, however, as did his predecessor, the importance of opening up further ground if the Rand's gold output is to be maintained after the next seven or eight years.

The following dividends have recently been declared for the half year ending June 30:

	Per Cent	Per Share s.	d.
Geduld Proprietary Mines, Ltd	17½	3	6
Modder Deep, Ltd	65	3	3
Leeuwpoort Tin Mines, Ltd	5	0	3
Lydenburg Gold Farm, Ltd	10	0	3
Meyer and Charlton G. M. Co., Ltd	10	2	0
Government G. M. Areas, Ltd	40	8	0
Langlaagte Estate & G. M. Co., Ltd	7½	1	6
New State Areas, Ltd	7½	1	6
Van Ryn Deep, Ltd	20	4	0
Witwatersrand G. M. Co., Ltd	3¾	0	9
Cape Portland Cement Co., Ltd	5	1	0
South African Coal Estate (Witbank) Ltd.	2½	0	6

Also, Rooiberg Minerals, 8¾ per cent; Apex Mines, Ltd., 5 per cent; Rand Mines, Ltd., 50 per cent; City Deep, Ltd., 5 per cent; Consolidated Main Reef Mines, 6¼ per cent; Crown Mines, Ltd., 32½ per cent; Modder B., 40 per cent; New Modder, 65 per cent; Rose Deep, Ltd., 2½ per cent; Robinson Deep, Ltd., "A" shares, 1s. 6d.; Sub Nigel, 25 per cent, equal to 2s. 6d. per share; Brakpan Mines, Ltd., 25 per cent; Springs Mines, Ltd., 16¼ per cent; West Springs, Ltd., 6¼ per cent; Van Ryn G. M. E., Ltd., 2½ per cent; and Johannesburg Consolidated Investment Co., Ltd., 7½ per cent.

The mineral output of Rhodesia for April was recently declared as follows: Southern Rhodesia—gold, 48,290 oz., value £204,875; silver, 7,807 oz., value £849; coal (raised) 72.059 tons, value £30,428; chrome ore, 25,178 tons, value £62,280; asbestos, 3,171 tons, value £58.568; mica, 59.648 lb. value £1,665; total value, £358,665. Northern Rhodesia—gold, 47.66 oz., value £200; silver, 6.72 oz., value 13s. 6d.; copper (finished), 188.31 long tons, value £7,433; lead 500 tons, value, £13,400; mica 0.67 tons, value £55; total value, £21.088.

The output of gold for May was declared on June 10 by the Transvaal Chamber of Mines, as 859,479 oz., having a value of £3,650,835. These figures are an increase over the April returns of 35,465 oz., equal in value to £150,646. Compared with March, the May total is 1,032 oz. lower.

Among the individual returns, Crown Mines show an increase of 6,296 oz.; New Modder, 3,854; Government Areas, 3,562; and E. R. P. M., 3,158; City Deep shows a decrease of 2,931 oz., caused by the recent strike of the miners on the property. The native labor returns show a decrease at the end of May of about 700 "boys" working on the gold mines of the Rand, compared with April 30.

A report recently issued by the Transvaal Miners' Phthisis Board shows that an aggregate amount of £8,146,412 has been paid in benefits under the Miners' Phthisis Acts since April, 1911, up to the end of the last financial year.

W. H. A. Lawrence, chairman of the Transvaal Consolidated Land & Exploration Co., Ltd., at the thirty-second ordinary general meeting of the company, recently held in Johannesburg, announced that the profits for the last year had reached a record total of £108,389.

At the annual meeting of the Central Mining & Investment Corporation, Ltd., held in London, on May 31, Sir R. Sothern Holland reviewed the company's mining position. The profit earned during the year by the corporation had been £668,586.

A fire broke out in Kimberley railway station goods sheds on the morning of June 4. The damage is estimated at £150,000, the sheds being completely destroyed. Explosions were caused by dynamite in some of the trucks; but the fire brigade removed two trucks containing petrol and paraffin to a place of safety.

Two parallel reefs of amethyst have been discovered on the property of M. A. Zoccola, near the Yokeskei River bridge, not far from the main road leading from Johannesburg to Pretoria. In its rough state, this mineral is said to be worth about 7s. 6d. per lb.

The Roan Antelope Copper Mines, Ltd., was recently registered in London with a capital of £600,000 in 5s. shares. This company is entering into agreements with the Northern Rhodesia Co., the Selection Trust and the Bwana M'Kubwa Co. to explore for copper.

S. H. Day, the new United States Trade Commissioner in South Africa, in a recent statement reviewed the mineral export trade with the United States. He said that the United States would require increasing quantities of minerals from South Africa.

Onverwacht Platinum, Ltd., milled 2,297 tons of ore during May, yielding 745 oz. of refined platinum and allied metals, equivalent to a recovery of 6.5 dwt. per ton milled. The prospecting shaft disclosed values averaging 3.18 dwt. between depths of 439 ft. and 450 ft. Crosscutting on the 450 ft. level is in progress.

Lydenburg Platinum Areas, Ltd., reports that during May 2,670 tons was milled on the Maandagshock section and 492 oz. of platinum-group metals won.

On the Johannesburg Stock Exchange during the last week there has been heavy liquidation and prices, in the main, have fallen. London sold to a considerable extent, particularly Modder East.

London Letter

By W. A. Doman
Special Correspondent

Group of Speculators Said to Be Attempting to Corner Spot Tin in London

London, July 12—Recently there has been something of a flurry in tin, the price of the metal having declined from £300 17s. 6d. to £282 12s. 6d. per ton since the beginning of the month. It is said that a group of speculators who have been successful in their operations in the share market have turned their attention to the metal and are attempting to corner spot tin. There has certainly been more tin put into warehouse during the past week, and the difference between spot and forward prices has narrowed considerably. The metal market, however, takes a complacent view of the situation, and so far the corner has not materialized. The only people who are profiting are the American consumers who are increasing forward contracts.

Apropos this metal, the discoveries in Tanganyika and Uganda Terriotry are attracting considerable attention. The Tanganyika Goldfields floated the Ankole Tin Fields and the Kagera (Uganda) Tin Fields. From the latter 20 tons of alluvial tin concentrates of good quality have been recovered, and J. C. Mance is conducting exploration work on the property with promising results. A third subsidiary, the Bukoba (Tanganyika) Tin Fields, has just been formed, and it is claimed that the existence of a new tin field has been definitely established.

Seeing that the Precious Stones bill which has been before the Union government has been thrown out by the Senate on the much-discussed retroactive clause, and that nothing further is likely to occur until the fall session, the fact that many new alluvial diamond companies are being formed in South Africa is worthy of note. The diggers naturally side with the Senate in their objection to abrogation of the existing laws under which they are working, and in Lichtenburg, Namaqualand, and other centers many new companies have been formed. This means that the Diamond Syndicate will have to absorb more alluvial stones and to reduce still further the production of the "Big Four"—i.e. De Beers, Jagersfontein, Premier, and the Consolidated Diamond Mines of S. W. Africa, if the trade is to be saved from collapse. Fears as to the outcome of the present position have led to heavy selling of De Beers deferred shares, the price of which has declined 23s. 9d. during the last two weeks.

It is reported that Sir Frederick Mills, with H. Guedalla, of the National Mining Corporation, is interested in quite another part of the world, having joined the board of the newly formed Bolivar (Venezuela) Gold Mines, which has a capital of £600.000 and which has acquired a property between the holdings of the New Goldfields of Venezuela and the French Mocupia Co. The venture is entirely a private undertaking.

Societies, Addresses, and Reports

Gaseous Reduction of Tin Concentrates

Colin G. Fink and C. L. Mantell Present Paper at General Meeting of the American Electrochemical Society

EXCERPTS are presented below from a paper entitled "Gaseous Reduction of Tin Concentrates," presented at the fifty-first general meeting of the American Electrochemical Society recently held in Philadelphia. The authors of the paper are Colin G. Fink, head of the division of electrochemistry at Columbia University, and C. L. Mantell, consulting chemical engineer, Pratt Institute, Brooklyn, N. Y.

In ordinary smelting practice the coal or coke of a reducing charge is active only as it becomes partially oxidized to carbon monoxide gas. Reduction of metallic oxides is not accomplished by reducing fuels in the solid phase. If a more efficient, cheaper, and more easily manipulated process would result from the gasification of the reductant outside of the smelting furnace, the possibility deserves careful consideration. The gaseous reduction of tin concentrates has been studied with this end in view.

The process of gaseous reduction depends for its success upon the absence of all slagging phenomena until complete reduction is effected. Even incipient fusion prevents the intimate or rapid contact of ore and gas, slowing down the reduction finally to complete stoppage when the ore particles become slagged or glazed over. In the particular Bolivian concentrates used in our study, no difficulty was encountered due to low fusing point tourmalines, gangue materials, or slagging ore constituents at the temperatures employed. After reduction the furnace charge was cooled in an atmosphere of hydrogen to below the melting point of tin. Iron was always found as oxides in the reduced charge.

Recovery of the Tin From the Reduced Charge

In its final solution, the method of tin recovery from the reduced charge was simple. The concentrates had the following analysis: SnO_2, 86.2 per cent; Sn, 67.95 per cent; Fe, 4.19 per cent; Fe_2O_3, 5.65 per cent; Sb, 0.04 per cent; As, 0.010 per cent; Cu, 0.036 per cent; Bi, 0.296 per cent; WO_3, 1.42 per cent; SiO_2, 1.73 per cent; and S, 0.28 per cent. If the ore charges were stirred or rabbled continuously during reduction, thus exposing fresh surfaces and allowing the molten tin particles to flow together, about 80 per cent of the tin metal content of the ore was directly liquated from a non-fluid slag. This metal was about 70 per cent of the weight of the concentrates charged into the furnace. The remaining 20 per cent of the tin metal content of the concentrates could be almost completely recovered by fusing the residues at 1,000 to 1,050 deg. C. when the gangue formed a very liquid slag and the metallic tin readily settled out. The slag contained only small amounts of tin amounting to 1 to 2 per cent of the total tin content of the original concentrates.

The final slags were from 10 to 12 per cent of the original weight of the ore. The tin contained all the reducible metals, Bi, Sb, Pb, Cu, and Ag, but only a small amount of the Fe. Arsenic was absent in the tin produced, and had evidently been volatilized in the process. Tungsten and molybdenum were reduced to their lower oxides only, and did not find their way into the metal.

Economics of Hydrogen Reduction of Tin Concentrates

Using hydrogen for tin concentrates reduction, a rough estimate of the power consumption is based on the following factors: One pound (454 grams) of metallic tin requires for its reduction from cassiterite (SnO_2), 6 cu.ft. (170 liters) of H_2 gas. One kilowatt-hour produces 7 cu.ft. (199.2 l.) of H_2 gas by the electrolysis of water. The theoretical value is about 9 cu.ft. (255 l.). Power requirements for H_2 production are therefore 0.86 kw.-hr. per pound of Sn metal, or 1,030 kw.-hr. per ton of 60 per cent Sn concentrates. The reaction is effected economically at 750 deg. C. At this temperature the power requirements for heating represent an additional 1.75 kw.-hr. per pound Sn, or 900 kw.-hr. per ton of 60 per cent concentrates. Total power requirements then appear as 1.6 kw.-hr. per pound Sn, or 1,930 kw.-hr. per ton of 60 per cent concentrates.

Smelting costs employing carbonaceous fuel reduction are about $48 per ton of 65 per cent concentrates. About 41 per cent of this cost is due to fuel, or $19.68 per ton of 65 per cent concentrates. The same operation by gaseous reduction, with power at $0.003 per kilowatt-hour, will amount to $5.97 per ton of concentrates. Even if power were as expensive as $0.01 per kilowatt-hour the total cost of energy for H_2 reduction would be $19.30 per ton of concentrates. Gaseous reduction would not have to carry the 1 per cent of the smelting cost for fluxes that carbon reduction entails, and the 15 per cent for general expense (a portion of which is for refractories) would most likely be materially reduced.

Strains in Hoisting Cable Recorded by Telemeter

The U. S. Bureau of Standards has been developing a photographic apparatus for measuring strains in structures produced by loads. The instrument is called a telemeter, and reproduces upon a photographic film the mechanical movement resulting from such strains. A report has been issued by the Bureau describing recent improvements in the instrument and showing photographic records of strains in a mine hoisting cable.

Deutsches Museum Contains Many Mining Exhibits

In the section of the Deutsches Museum, at Munich, Germany, devoted to the mining industry and the mining sciences, a large collection of mining machinery, much of which is of full size and in operation, may be inspected; also, there are numerous full-sized models of shafts and passageways,

"Mining Potash Salts." Exhibit in Deutsches Museum, Munich, Germany

made from plaster casts in actual mines. There are also exhibits, likewise full size, and correct to the smallest details, showing underground operations in the coal, salt, potash, and iron mines of the country. One of these exhibits, "Mining Potash Salts," shown in the photograph above, is an exact reproduction of a room in a German potash mine.

Chemical, Metallurgical and Mining Society Meets

At the meeting of the Chemical, Metallurgical and Mining Society of South Africa held in Johannesburg on May 21 Professor H. H. Paine gave an illustrated lecture on "Supra-conductivity: The Disappearance of Electrical Resistance at Low Temperatures." The president of the society, H. R. Adam, read a paper entitled "A Note on a New Palladium Mineral."

Geological Society of South Africa Holds Meeting

The monthly meeting of the Geological Society of South Africa was held in Johannesburg on May 28, when the following papers were read: "The Talc Deposits Near Kaapmuiden, in the Eastern Transvaal," by Dr. A. L. Hall, and "The Location of Payable Orebodies in the Gold-Bearing Reefs of the Witwatersrand," by Dr. L. Reinecke.

Recent Technical Publications

Reviews, Abstracts, and References

Der Flotations-Prozess. Von C. Bruchhold. Julius Springer, Berlin, W. 9, Germany. Price, 27 marks.

Mr. Bruchhold's book is meant to serve the practicing flotation engineer. For that reason the author describes only machines and processes that are in practical use, without wasting any space on history, patent situation, and kindred matters. As he considers the flotation process to be a product of American experience, he confines himself to American practice, with which he tries to familiarize the German reader. The manner in which he utilizes the American literature on the subject is interesting to note. He says regarding this point: "References to the literature were omitted because much material taken from the American technical journals had to be modified and shortened." Such a course may be justified from a strictly utilitarian standpoint, but it can hardly be approved from an ethical one. The adoption of this policy had the result that, although the files of the American journals were extensively utilized, none of these journals which did their share in the development of the process by printing valuable papers dealing with it are mentioned at all. Likewise the men who contributed to the development of the process may find their work and their ideas on the subject reviewed (they may even find their drawings reproduced), but may not find their names mentioned.

That the book represents a diligent compilation cannot be denied. Mr. Bruchhold has tried to correlate logically the miscellaneous facts that represent our present-day knowledge of the flotation process and to establish certain conclusions. Perhaps he has not been able to resist the temptation to generalize more than is advisable. For instance, he says: "The more frothing agent (pine oil) is added to the collecting oil (tar), the purer will be the concentrates and the higher the metal contents of the tailing." This may be true under certain conditions within a certain range, but stated as a generality it is certainly not correct. Or, "Pneumatic flotation machines generally produce purer concentrates, whereas agitation machines as a rule produce purer tailings." Any experienced millman can make high concentrates and low tailing, or low concentrates and high tailing, with any machine.

Bruchhold's discussion of flotation practice in certain well-known installations is interesting. For instance, of Inspiration's plant he states that tailings from the flotation machines are classified into sand and slime, the sand being re-treated on tables and the slime sent to waste. His comment in this instance is that it probably would have been more correct to separate the barren slime before sending it to the flotation machines. This would serve the purpose of lowering its load. The conclusion would be correct if the slime were barren before flotation, but it is not.

Summing up, we might say that the book may be worth reading even for the American flotation man, but as none of the conclusions at which the author arrives are supported by any figures it should be done with a great deal of caution. RUDOLF GAHL.

Fluorspar, Its Mining, Milling and Utilization, with a Chapter on Cryolite. Bulletin 244, 1927, U. S. Bureau of Mines. By R. B. Ladoo. Pp. 185. Illustrated. Price, 35c.

Fluorspar is regarded as an essential fluxing material in the basic open-hearth steel furnace, and steel manufacture by this process has become so important that it absorbs 80 to 85 per cent of the domestic fluorspar production. The high cost of mining and milling, together with some uncertainty regarding the extent of reserves, and the increasingly keen competition from imported spar, led the U. S. Bureau of Mines to make a complete survey of the industry. The author visited practically all the mines and known deposits in the country, and conferred with the more prominent operators. Through consuls of the United States in various parts of the world, and from other sources, he obtained much information on foreign operations and reserves. The field work was done in 1921, 1922, and 1923, and the descriptions of mines and mills apply to conditions existing during that period. Figures for both domestic and world production are given for a period of years, and the question of reserves is discussed fully. The conclusion is reached that world reserves are limited, and that consumption is increasing greatly. Consequently the supply should be conserved by careful mining and by economical milling. The fluorspar district of Rosiclare, Ill., and adjacent Kentucky, being the most important in the country, is described in considerable detail. Mining methods are also described, and the milling of fluorspar is illustrated with detailed flow sheets. Grades and specifications are given for the various uses to which fluorspar is applied. Deposits and operations in Colorado, New Mexico, Arizona, Nevada, and other states are described. Concise data are supplied on foreign deposits in Canada, Central and South America, Europe, Asia, Africa and Australia. The chapter on cryolite deals mainly with the deposit at Ivigtut, Greenland. The bulletin is the most comprehensive report on the subject now in print, and should be of particular interest to steel metallurgists. OLIVER BOWLES.

Assaying for Cobalt—The May number of *The Mining Magazine* (London) contains an article written by J. E. Clennell on the analytical separation of cobalt and nickel. The article is entitled "The Estimation of Cobalt by the Nitroso-Beta-Naphthal Method."

Canadian Mining—The July issue of the *Canadian Mining and Metallurgical Bulletin* contains the following papers, which will be presented at the Toronto meeting of the Empire Mining and Metallurgical Congress, Aug. 25-26: "The Silver Mining Industry in Canada," by Arthur A. Cole; "Nickel—Past and Present," by Robert C. Stanley; and "Precious Metals in the Sudbury Ores and Their Recovery," by C. Langer and C. Johnson. Copies of the bulletin may be obtained for $1 from The Canadian Institute of Mining and Metallurgy, 604 Drummond Building, Montreal, Canada.

Asbestos—As a supplement to the July issue of *Asbestology*, B. Marcuse, the publisher, is distributing an attractively bound reprint of the paper of J. G. Ross, of Montreal, on "Asbestos Mining and Milling," which will be discussed at the Quebec meeting of the Empire Mining and Metallurgical Congress on Sept. 5. The article is a comprehensive one and details the technical and engineering methods of exploiting what Mr. Marcuse calls "the world's most important non-metallic mineral."

Alexander Bay Diamonds—The May 18 number of the *Mining and Industrial Magazine* (Johannesburg, South Africa; price 6d.) contains an interview with Dr. Hans Merensky in which he tells the story of his discovery of diamonds at Alexander Bay.

Patents

Drill Sharpener—No. 1,629,175. May 17, 1927. Arthur E. Peters, Littleton, Colo., assignor to Ingersoll-Rand Co., Jersey City, N. J. Design for a drill sharpener.

Rock Drill—No. 1,629,179. May 17, 1927. Fred M. Slator, Easton, Pa., assignor to Ingersoll-Rand Co., Jersey City, N. J. Design for a fluid actuated rock drill of the hammer type.

Rock Drill—No. 1,629,730. May 24, 1927. Ernest Penberthy, Detroit, Mich., assignor to Chicago Pneumatic Tool Co., New York City. A method of lubricating percussive tools having a piston chamber and an impact reciprocating impact piston.

Rock Drill—No. 1,629,845. May 24, 1927. Edward W. Stevens, Detroit, Mich., assignor to Chicago Pneumatic Tool Co., New York City. A design for a sleeve valve percussive tool.

Safety Blasting Cap Box—No. 1,629,423. May 17, 1927. Anton Turk, Johnstown, Pa. A safety blasting cap box consisting of a block having numerous vertical openings forming cap-receiving wells.

Feeding Mechanism—No. 1,629,968. May 24, 1927. Adelbert H. Richards, Salt Lake City, Utah, assignor to American Smelting & Refining Co., New York City. A design for a metallurgical furnace-feeding mechanism.

Crusher—No. 1,630,194. May 24, 1927. James G. Malone and John A. Dormer, Detroit, Mich. A design for a rock- or ore-crushing machine.

Mine Cars—Nos. 1,626,653 and 1,626,654. May 3, 1927. Victor Willoughby, Ridgewood, N. J., assignor to American Car & Foundry Co., New York City. Designs for mine cars.

Personal Notes

Sherwin F. Kelly is in New York.

A. V. Eulich has returned from Colombia and is residing temporarily at St. Joseph, Mo.

Burr Wheeler, general manager of the Chile Exploration Co., is now in the United States on a vacation.

C. M. Hoebecke has been appointed chief engineer for the Chile Exploration Co. at Chuquicamata, succeeding H. M. Dougherty.

Carl Davis, consulting engineer to the Anglo-American Corporation of South Africa, Ltd., has left Johannesburg for Broken Hill, in Rhodesia.

B. D. Bushell, manager of West Springs, Ltd. (Transvaal), has been assigned to professional service for six months with a copper mine in the Broken Hill district, Rhodesia.

Eleanora B. Knopf, of the Geologic Branch of the U. S. Geological Survey, will be engaged for about six weeks on a study of the physiography of Baltimore County for the Maryland Geological Survey.

Frank Reeves, of the Geologic Branch of the U. S. Geological Survey, has been furloughed for four months and left Washington on July 9 for western Canada, where he will do exploratory geologic work.

Dr. Erich Kaiser, of Munich University, is spending a few months in South Africa. He is collecting data for a projected work, "The Geology of Arid Climates," and is the author of "The Diamond Desert of South West Africa."

H. D. Miser, of the Geologic Branch of the U. S. Geological Survey, has been placed in charge of the section of geology of fuels, and **G. R. Mansfield** is now geologist in charge of the section on non-metalliferous geology.

Axel O. Ihlseng is at the property of the Keystone Gold Mining Co. at Keystone, S. D., advising on the opening of a famous group of gold properties which include the Holy Terror mine, once the leading producer of the Black Hills.

R. B. Harkness, Natural Gas Commissioner of Ontario, has been appointed by the Provincial Department of Mines to investigate the china-clay deposits in the Mattagami River district to ascertain their extent and commercial value.

G. F. Loughlin, of the U. S. Geological Survey, left Washington, D. C., on July 18 for an inspection trip in Colorado, Idaho, Utah, and Montana, after which he will return to Colorado to continue the study of ore deposits in the Cripple Creek and other districts.

Sir George Cory, late professor of chemistry at Rhodes University College, Grahamstown, Cape Colony, South Africa, celebrated his sixty-fifth birthday, recently. Sir George is honorary archivist to the Union Government and has written an excellent history of South Africa.

G. Chester Brown, for a number of years chief mine inspector for the Industrial Accident Commission of California, has resigned that position and accepted the post of safety engineer with the California Metal and Mineral Producers' Association, with headquarters in San Francisco.

Howard C. Davis, of Boston, chairman of the board of directors of the Central Manitoba Mines, is visiting the company's property at Long Lake, Manitoba. He stated in an interview that great interest was being taken by Boston financiers in the development of Manitoba mineral lands.

J. F. Kapnek, managing director of the Manica Trust, Ltd., has left Capetown for England and will proceed to the United States and Canada. He will attend the Empire Mining and Metallurgical Congress at Montreal in August, where he and **George A. Denny** will represent the Bulawayo Chamber of Mines.

Fred Carroll

E. E. Whiteley, superintendent of the Calumet & Arizona Mining Co., at Warren, Ariz., had three ribs and a collarbone broken recently, when the car in which he was riding blew out a tire on the rear wheel and overturned. Mr. Whiteley is being cared for at the Calumet & Arizona hospital, and physicians report that he is making a rapid recovery.

H. G. Peake announces the dissolution of the copartnership known as the Union Construction Co. and his removal to the Alexander Building, at 155 Montgomery St., San Francisco. The new firm name is H. G. Peake Engineering Co. This firm will be engaged in the design and building of dredges for all purposes and other engineering work incidental to mining and milling operations.

R. W. Rusterholz, managing director of the Ingersoll-Rand company in South Africa and district governor of Rotary International (55th District) has been absent from Johannesburg to attend the Rotary Conference at Capetown. Mr. Rusterholz will proceed to England and America. After visiting the States he attended the International Rotary Convention at Ostend.

Fred Carroll

An Appreciation

The death of Fred Carroll at Denver on March 26, 1927, brought sadness to unusual numbers of people. Born in Hiwassee, Georgia, on May 26, 1874, he was brought by his parents to Rosita, in the Wet Mountain Valley of Colorado, in 1880. Seven years later the family trekked further west, with considerable herds of cattle. Carroll came to manhood in the cattle industry and remained an active participant in the family business until 1902. In these years he completed his college-preparatory work and did some university work at Boulder. He played a good "end" in football, and showed the skill in harmonizing that was to make him notable later.

The family, harking back to earlier mining experience in the southern Appalachians, took over the Atlas mine, at Ouray, and organized the Atlas Mining & Milling Co., Carroll being its general manager until his death. The project was difficult, but the general plan was good and was well executed. An industrious and painstaking student, he sensed that his metallurgical salvation was to be found in flotation and installed one of the first two plants in Colorado, in 1913. In 1923 he recognized a new and critically important aid in xanthate. Unfortunately, before he could benefit, the abrupt and unlooked-for termination of purchases under the Pittman Act crippled the mine, and an untimely fire caused suspension. In 1924 Carroll joined D. D. Potter in the Federal Shale Oil Co. and contributed to it largely, first in perfecting titles and later in convincing major oil interests that large-scale mining methods give the great shale beds of western Colorado enormous value. Consequent on the successful operation of flotation in 1914, Mr. Carroll, to recuperate in health, accepted appointment as State Commissioner of Mines in 1915. He adorned the office for six years. During this time he served as secretary of section of the A.I.M.E. and as Director of the Mining Bureau of the Denver Chamber of Commerce. He was a member of the War Minerals Commission in wartime.

In 1921 Carroll was instrumental in having enacted the law creating the Metal Mining Fund and was made a director for the first six-year term. He was later member of the Committee of Fifteen of the Silver Producers' Association.

In his political activities Fred Carroll was at his best, and politics benefited. Successively secretary of the Republican State Central Committee, comanager for five states of the Harding campaign of 1920, and successful manager of Mr. Waterman's campaign for seat in the U. S. Senate in 1926, he found good scope for his abilities. He declined offers of excellent positions in the gift of the national administration. His sister, Mae Carroll Fry, a member of the Colorado Legislature, and his brother Frank Carroll, well known in the industry, survive. Carroll's life was full of the picturesque and gave him wide acquaintance. He was a delightful companion. His loyalty was of a class apart. C. A. C.

Market and Financial News

Germany Increases Consumption of Non-Ferrous Metals

By Dr. James Rubinfeld
Special Correspondent, Berlin

METAL manufacturing trades in Germany are profiting by the increasing domestic demand for metal products. This conforms with the all-round revival of German economic life, which was started a year or so ago by the British coal stoppage and has since continued to make steady headway. The demand for metal products has already caused heavy importing of brass and otner copper materials, despite existing overcapacities of mills built or enlarged in war times. As things stand, we are again nearing normal limits of metal consumption, and decidedly there is a remarkable progress as compared with conditions of the last calendar year, as may be seen from official import statistics shown in the accompanying table.

German Metal Imports January-May in Metric Tons

	1927	1926
Copper	86,901	48,149
Lead	48,478	29,329
Zinc	53,980	29,353
Tin	5,802	3,005
Nickel	1,394	620
Antimony	1,397	807
Aluminum	3,943	1,449

It is being suggested by those who talk of oversupply that a good deal more American copper, Mexican or Australian lead, and other metals is here in the yards waiting for application than manufacturers require for immediate use. According to my own observations, there can be little oversupply of raw metal in Germany, for buyers still are following a cautious hand-to-mouth policy because of weak markets.

In German circles a genuine amazement rules at what people here call an "awkward" price policy of the Copper Exporters, Inc., and the opinion is often expressed that the cartel has, so far, succeeded neither in stabilizing nor regulating copper prices. As a matter of fact, the Brussels officials seem to be often "sitting" upon 13c. per pound of electrolytic, when plenty of the metal is being offered here at 12.95 and 12.90c. Some bitterness is being felt by manufacturers of the copper products because their colleagues in the United States are favored by lower prices f.a.s. New York and the c.i.f. prices asked in Rotterdam, London or Hamburg. They hold that American copper or brass manufacturers are being placed in position unfairly to compete with the European makers in the world markets. The rolling mills of the Mansfeld or of the Metallgesellschaft (both members of the cartel) thus stand in a less favorable position than those of the American companies. Nevertheless, it would appear that the German members still adhere to the cartel principle, seemingly because they otherwise would have to take a chance on lower prices, whereas they at present can at least sell all they produce at the fixed price.

The outlook for the formation of the European zinc syndicate once more seems good. The main difficulties lie in the attitude of small producers—in Upper Silesia and in Belgium—as well as, to some extent, that of the English smelters that are favored by Australian deliveries of concentrates. Not only have the Hirsch and the Donnersmarck concerns expressed their aversion to giving up their independence for the sake of joint selling methods, but the Stolberg interests also seem to be willing to bide their time. Meanwhile a statistical board has been set up in Silesia to gather dependable figures on production of raw zinc; also of byproducts, the sources of ore supplies, their contents, and so on. But since the influence of Anaconda has been potent in Giesche's affairs, the whole matter requires a fundamentally different solution, because of the overwhelming position of Great Falls in the world zinc trade. Last but not least, the big projects of Anaconda regarding electrolytic zinc are subjects of grave concern. The opinion is expressed that in the course of time the electrolytically refined metal may displace even the good Giesche brands in the same way as some twenty years ago copper wirebars began to push aside fire-refined copper.

The fact that Anaconda heartily approves the formation of a European zinc syndicate and has recently concluded agreements with certain European producers, together with the further fact that it holds a controlling interest in the Giesche Spolka Akcyina, is felt to be a paradox, since it would appear that the company desires to stabilize prices but at the same time is preparing to increase enormously both Silesian and United States production.

Burma Corporation Mines 38,003 Tons of Ore in June

Cable reports dated July 8 state that during the month of June the Burma Corporation, Ltd., mined 38,003 tons of ore, including 3,364 tons of high-grade ore. The treatment plant milled 30,500 tons of ore, producing 11,110 tons of lead concentrates. The blast furnaces smelted 12,534 tons of lead-bearing material, including 2,857 tons of high-grade ore, producing 5,376 tons of hard lead for treatment in the refinery. Refinery products were 5,417 tons of refined lead, including 508 tons recovered from the smelting of copper ore, and 474,319 oz. of refined silver. Of the silver production 51,648 oz. was recovered from the treatment of copper matte. The zinc plant produced 5,230 tons of zinc concentrates, assaying 13.3 oz. silver, 8 per cent lead and 46.8 per cent zinc.

In addition to the above 1,011 tons of copper matte was produced from the treatment of accumulated smelter by-products and 5,522 tons of copper ore. Also, 52 tons of antimonial lead was produced.

Statistical Notes

Dome Mines, Ltd., reports the milling of 266,700 tons of ore during the first six months of 1927, with the following financial returns, earning being calculated before allowance for appreciation or depletion:

Total recovery, $7.288		$1,943,686
Operating and general costs, per ton, $4.179	$1,114,538	
Estimated Dominion and U. S. taxes	48,789	1,163,328
Operating earnings		$780,357
Miscellaneous earnings		110,753
Total income		$891,111

Ashanti Goldfields Corporation reports May production as 8,656 tons (of 2,000 lb.) crushed, yielding 8,438 oz. of fine gold. Estimated value was £35,844 and estimated profit for the month, £14,252. The high output was the result of unusually high-grade ore found in the stopes during the latter part of the month, in conjunction with the greater tonnage treated.

Kay Copper shares were artificially inflated by James J. Godfrey and others, according to a complaint made by the Attorney General of New York. Declaring that $5,000,000 worth of stock had been floated, Deputy Attorney General Mackey Rackow recently applied to Supreme Court Justice Cropsey, in Brooklyn, for an injunction against Godfrey, president of the corporation; E. H. Whiting & Co., brokers; and other defendants, including Thomas Hassett, Charles Boyd, and Bernard Scheftels, a trader.

Mr. Rackow told the court that Godfrey floated the stock, and that it was sold to him at an average price of 43c. a share. Godfrey, he said, hired Scheftels and installed Boyd and Hassett, his clerks, in a separate office as "Boyd, Hassett & Co." Through manipulation, Rackow charged, Godfrey manufactured an artificial price for the stock, selling it at as high as $1.50 per share.

Merging of a number of the leading wire and cable companies of the country is under way, according to what are considered reliable financial sources. The companies that were mentioned in connection with the merger are the Standard Underground Cable Co., the Rome Wire Co., the Bal-

timore Copper Smelting & Rolling Co., the Safety Insulated Wire and Cable Co., the Habirshaw Electric and Cable Co., and the Dudlo Manufacturing Corporation. The current report is that the new corporation to be formed will issue 5½ per cent bonds, 6 per cent cumulative preferred stock, and no-par-value common stock. The preferred will be offered at $90 to $93 a share and the common at about $50 a share.

Soviet Russia plans to develop its metal industry during the next five years through the erection of new plants, mainly along American lines, to cost $300,000,000, according to an announcement made recently by a delegation of six Soviet engineers representing the "Gipromez," the Metal Institute at Leningrad. The engineers will remain here for three or four months, visiting American plants and consulting American engineering authorities. It is probable that one or more American engineering firms may be engaged to act as consultants for the new construction.

Exports of chromite from New Caledonia and New Hebrides for March totaled 7,787 metric tons, of an average content of 49 per cent Cr_2O_3. Of this, 6,350 tons was produced by the Tiebaghi company. The March exports bring the total for the first three months of the year to 10,835 metric tons.

Arizona Mine Valuations Increased by Tax Commission

The report of the Arizona State Tax Commission for 1927, just issued, indicates an increase in the value of producing mines of $11,250,298 over the 1926 valuation. Some mines have decreased, but the total shows a substantial increase. Of the producing mines, the Phelps Dodge Corporation's Morenci Branch showed an increase of nearly $5,000,000 over the 1926 valuation; the Magma Copper Co., at Superior, an increase of about $2,000,000, and the New Cornelia Copper Co., an increase of about $1,000,000.

Comparing valuations, the Copper Queen Branch of the Phelps Dodge Corporation, Inspiration Consolidated, and United Verde Copper were valued at between $34,500,000 and $34,800,000 each. New Cornelia Copper Co. came next, with an assessed valuation of $29,335,000; and Calumet & Arizona, Ray Consolidated, United Verde Extension, and the Morenci Branch of the Phelps Dodge Corporation were variously assessed at figures ranging between $22,800,000 and $25,900,000, the Morenci Branch of the Phelps Dodge being the lowest and Ray Consolidated the highest in this last-named group. The Miami Copper Co. was valued around $17,600,000, and a valuation of $13,200,000 was placed on the Magma Copper Co. at Superior. Old Dominion, in Globe, was listed at $7,500,000 in round figures, and the Shattuck Denn Mining Co. and the Arizona Commercial each received a valuation around $1,900,000. The Iron Cap Copper Co. was valued at $360,000. Total valuation placed on the producing mines in the state was $275,242,627, against $263,992,329 for 1926.

Semi-Annual Dividend Payers Increase Total Distribution for Quarter

THE PRESENCE of several corporations that pay large dividends on a semi-annual basis brought the total disbursements by mining companies in July well above the total of April, the corresponding month in the second quarter of the current year. Though there are names in the list that were not there in January, some "casualties" are also to be noted, so that the total for July is almost the same as in the opening month of the year.

Among those that pay regularly at semi-annual periods are Consolidated M. & S. of Canada, accounting for $3,170,975—most of which is nominally $5.40 per share, and the directors promise that with "normal" metal prices the $4 annual rate ought to be maintained.

Companies that passed dividends that have been paid more or less regularly in recent years include Gladstone Mountain, a high-grade lead producer in the State of Washington; Ahumada Lead, also a producer of lead but in northern Mexico; the Consolidated Lead & Zinc Co., subsidiary of the Eagle-Picher Lead Co.; and Inspiration Consolidated Copper Co. The last named announced this move more than a month ago, giving as the reason the known as an extra, but which is far more than earned by current operations; Mining Corporation of Canada, Virginia Iron, Coal & Coke, and Arizona Commercial. Dome Mines, which is now paying when, as, and if warranted, paid $0.25; the Douglas Mining Co., a small shipper in the Cœur d'Alene area in Idaho, and the Plutus Mining Co., a subsidiary of the Chief Consolidated in Utah, were among the irregular payers, as was also New Jersey Zinc, which appeared with $2 distributions in both the February and May lists. In recent years the company has paid four regular dividends of $2 each and two extras of similar amount. The July payment of the company comes under this latter category.

Granby Consolidated paid $1 on July 1, the first payment since May in 1919. Earnings for the year 1926 are calculated to be equivalent to about $5.40 per share. Inspiration Consolidated Copper Co. has paid $5 per share annually since 1923, and in addition paid $1 per share in 1924 and $2 per share in 1925. Nipissing, Cobalt silver producer, cut its dividend from 15c. to 7½c. quarterly, and Arizona Commercial from 50c. to 25c. One increased rate is that of Newmont Mining Corporation, the holding company sponsored by W. B. Thompson, which number among its assets large blocks of Kennecott, Texas Gulf Sulphur, Chile Copper, Cerro de Pasco, Anglo American Corporation of South Africa, Consolidated Main Reef, Standard Oil of California, Continental Oil, and others. At least this represented the main holdings at the time of the most recent report. Earnings from dividends and realization on market transactions in the stocks of the various corporations mentioned have been considerably in excess of the increased rate of dividend.

unwisdom of depleting the ore reserves of the mine at the present prices for copper. Nipissing, Cobalt silver producer, cut its dividend from 15c. to 7½c. quarterly, and Arizona Commercial from 50c. to 25c. One increased rate is that of Newmont Mining Corporation, the holding company sponsored by W. B. Thompson, which number among its assets large blocks of Kennecott, Texas Gulf Sulphur, Chile Copper, Cerro de Pasco, Anglo American Corporation of South Africa, Consolidated Main Reef, Standard Oil of California, Continental Oil, and others. At least this represented the main holdings at the time of the most recent report. Earnings from dividends and realization on market transactions in the stocks of the various corporations mentioned have been considerably in excess of the increased rate of dividend.

Mining Dividends and Yields, for July, 1927

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
Aluminum Co. of America, pfd	Various	$1.50 Q	$1,104,570	5.8
Arizona Commercial, c	Ariz.	0.25 S.A.	66,250	....
Bingham Mines, s,l	Utah	1.00 Q	50,000	9.3
Bunker Hill & Sullivan, l,s	Idaho	0.75 M	245,250	9.7
Cleveland-Cliffs Iron	Mich.	1.00	400,000	4.8
Cresson Consolidated Gold	Colo.	0.10 Q	122,000	18.8
Douglas Mining, l,z,s	Idaho	0.0175 I	14,936	....
Eagle-Picher Lead, pfd., l,z	Okla., Mo.	1.50 Q	12,769	5.2
Homestake Mining, g	S. D.	0.50 M	376,740	j11.4
Inland Steel, pfd	Minn.	1.75 Q	175,000	6.2
Kennecott Copper	Alaska	1.25 Q	5,620,754	8.2
Magma Copper, c,s	Ariz.	0.75 Q	306,116	9.1
New Jersey Zinc	New Jersey	2.00	982,000	....
Newmont Mining, h	Various	1.00 Q	452,760	5.2
Nichols Copper, pfd	N. Y.	1.75 Q	40,173	....
Park Utah Consolidated, s,l,z	Utah	0.20 Q	418,700	12.8
Phelps Dodge, c	Various	1.50 Q	750,000	5.0
Plutus Mining, s,l	Utah	0.10 I	100,000	....
Portland Gold	Colo.	0.02 Q	60,000	23.0
Republic Iron & Steel, pfd	Various	1.75 Q	437,500	6.7
Silver King Coalition, s,l	Utah	0.25 Q	304,025	12.7
Sloss Sheffield Steel & Iron, pfd	Ala.	1.75 Q	117,250	6.5
U. S. Smelting, Refining & Mining, s,l	Various	0.875 Q	307,226	9.8
U. S. Smelting, Refining & Mining, pfd	Various	0.875 Q	425,556	7.2
Virginia Iron, Coal & Coke	Va.	2.50 S.A.	125,000	7.7
Companies in other countries:				
Asbestos Corporation, pfd	Quebec	1.75 Q	130,482	8.0
Consolidated M. & S. of Canada	B. C.	6.25 S.A.X.	3,170,975	5.5
Dome Mines, g	Ont.	0.25 I	238,333	....
Erupcion, l,s	Chihuahua	0.075 Q	93,750	54.5
Granby Con., c	B. C.	1.00 Q	432,000	11.0
Hollinger Consolidated Gold	Ont.	0.10 4 wks.	492,000	6.3
Howe Sound, s,c,l	B. C., Mex.	1.00 Q	496,038	10.5
Lucky Tiger-Combination, g,s	Sonora	0.05 M	35,767	8.7
Mining Corp. of Canada, s	Ont.	0.125 S.A.	207,506	....
New York & Honduras Rosario, g,s	Honduras	0.50 QX	100,000	....
Nipissing, s	Ont.	0.075 Q	90,000	6.0
Premier Gold, s,g	B. C.	0.08 Q	400,000	15.0
San Francisco Mines of Mexico, l,z,s	Mex.	1s. 6d. I	£112,796	....
Total			$18,901,426	

s, silver; l, lead; z, zinc; g, gold; c, copper; h, holding; Q, quarterly; M, monthly; X, extra; QX, $0.25 regular and $0.25 extra; SA, semi-annually; S.A.X, $1.25 semi-annual and $5 bonus; I, irregular; j, based on dividends for the last twelve months.

The Market Report

Copper and Lead Prices Continue to Advance—Zinc Steady and Moderately Active—Tin Dull

New York, July 27, 1927—The week ended today has witnessed further advances in prices for both copper and lead in the domestic markets. Copper is up ⅛c., to 13c. delivered in Connecticut; and the price for New York lead has advanced from 6.30 to 6.50c., with premiums over the price of the leading interest in evidence most of the week. The volume of business in copper has been neither unusually large nor small, although some sellers have declined orders at the prevailing prices. Lead was exceptionally active for several days, but has quieted somewhat. Zinc was reasonably brisk, with prices hardening a little in the middle of the week, but closing a trifle easier. Tin has been dull, but prices have shown little change. Antimony has strengthened a little, with some buying on the part of consumers. Quicksilver continues dull and easy, as do platinum and palladium. Silver is steady.

Daily Prices of Metals

July	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
21	12.65@12.775	62.50	64.00	6.40@6.50	6.25	6 30@6.325
22	12.75	62.25	63.875	6.50	6.30	6.30@6.325
23	12.775@12.80	62.25	63.75	6.50	6.325	6.325
25	12.775	62.50	63.75	6.50@6.60	6.35	6.325
26	12.775@12.80	62.625	63.75	6.50@6.60	6.35	6.325@6.35
27	12.775	62.50	63.625	6.50	6.325	6.325
	12.765	62.438	63.792	6 508	6 317	6.323

Average prices for calendar week ending July 23, 1927, are: Copper, 12.646; 99 per cent tin, 62.417; Straits, 63.896; N. Y. lead, 6.360; St. L. lead, 6.160; zinc, 6.265; and silver, 56.646.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis: i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

July	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
21	55 9/16	55 13/16	60½	288½	283	24⅜	24⅞	28¾	28½
22	55½	55¾	60½	287½	281¾	24⅜	24⅞	28 11/16	28 7/16
25	55 15/16	56¼	60¾	288½	282⅞	24⅜	24⅞	29 1/16	28 11/16
26	55 11/16	55⅞	60¾	289	283	23 13/16	24 7/16	28⅞	28½
27	55½	55¾	60¾	288½	283⅛	23 15/16	24 5/16	29	28 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

July	Sterling Exchange "Checks"	Silver		Gold London	July	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
21	4.85 1/16	56⅜	26 1/16	84s11½d	25	4.85 1/16	56¾	26⅜	84s11½d
22	4.85⅛	56½	26 1/16	84s11½d	26	4.85 1/16	56⅝	26 1/16	84s11¼d
23	4.85 1/16	56¾	26⅛	.....	27	4 85⅛	56⅝	26 1/16	84s11½d
					Avg.		56.646		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forencon. Cables command one-half cent premium.

Copper Established at 13c

Probably the outstanding feature of the copper market is the confident attitude of the producers. The nervousness that has characterized many of them every time the market has started upward heretofore this year is absent. Buying has not been particularly heavy during the week, but without exception sellers are asking 13c., and one or two are out of the market at this level. A strong factor has been the active foreign buying. The price of the export association was advanced from 13c. c.i.f. to 13.15c. on July 21, and on Monday, July 25, a further advance to 13.25c. was made. This was after the domestic market had been pretty well established at 13c. in the Valley. The effect was to dull the appetite of foreign buyers for the time being, but sales for the month of July will total close to 60,000 tons, or nearly as much as in the excellent month of May. Sales on last Thursday in the domestic market were at 12¾ and 13c. and on the split between. On one lot 13c. was shaded on Friday, but nothing has been sold under that figure since. A few large sales in the Middle West brought 13.125c., and account for the slightly higher quotations on July 23 and 26. It is thought in some quarters that the pending consolidation of several large wire companies has caused their customers to hold back, and that the consummation of the deal will be followed by more active buying from that direction. The American Brass Co. has made another advance in the prices of its products, this being the second within ten days. The basis is now a 13c. copper market.

Active Lead Buying

As generally happens when the lead market turns upward after a protracted decline, buyers suddenly discovered that they were in dire need of large tonnages of metal. Last Thursday and Friday and the following Monday lead sellers were swamped with inquiries. So far as they felt that regular customers were in actual need, their requirements were met by selling agencies, but the agencies declined to hand out unlimited quantities The man who asked for 1,000 tons had to be content with 100 or 200, and smaller inquiries were pared in proportion. Nevertheless, the total volume of sales was very large, with selling in the West probably more active than in the East. The American Smelting & Refining Co., faced with premium business in the outside market, raised its official contract price for New York lead twice: from 6.30c. to 6.40c. on July 21, and to 6.50c. on July 22. The leading interest in the West raised its price to regular customers to 6.30c. on July 22, and since then has been willing to take attractive business at 6.325c. Fancy prices ranging up to 6.45c. in St. Louis and to 6.70c. in New York were obtained during the early part of the week, but the market, steadied by the conservative attitude of the larger producers, seems to have regained normal equilibrium, for the present at least. No famine of lead is in sight; and though a steady and moderate advance in prices may be ahead of us, a phenomenal advance is not warranted. If such

a thing should be forced on the market, producers see the probability of another slump as a consequence.

Zinc Rises and Falls

Zinc prices have fluctuated within narrow limits, with the volume of business up to normal. Brass Special grades have been particularly active, although the premium has usually been closer to 2½ points than to 5. The statistical position of the metal is improving. The rate of world production in June was lower than that of May; and curtailment in American smelters' output is in effect. Prompt, July, and August are in most demand, with producers asking slightly higher prices for October. High Grade is nominal in a dull market at 8c. for carload lots in the New York district.

Tin Continues Quiet

Consumers in the domestic market showed little interest in tin last week. Prices for Straits are slightly easier than a week ago, and spot, prompt, August, and September deliveries can be had at the same prices. Tin of 99 per cent grade is in a little better position than Straits. In London there is a backwardation of nearly £6 per ton.

Silver Holds Gains

In the last week the silver market has fluctuated within very narrow limits, but at a somewhat higher level than obtained during the early part of this month. Selling has come mainly for China account, though India has continued to be a moderate buyer. The undertone at present is steady.

Mexican dollars (Old Mexican pesos): July 21 and 22d, 42⅞c.; 23d and 25th, 43c.; 26th and 27, 42⅞c.

Foreign Exchange

Changes in the principal foreign exchanges have been slight. On Tuesday, July 26th, closing cable quotations were as follows: French francs, 3.91⅜; lire, 5.44; marks, 23.77½. Canadian dollars $\frac{7}{64}$ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 98 or 99 per cent grade, price of leading interest, 26c.; outside market, 25.30@25.80c.

Antimony—Per lb., duty paid, New York: Chinese brands, range for the week, spot business, 11⅞@12⅜c. September arrival firmer. Market shows more life, with some buying by consumers. Cookson's "C" grade, spot, 17¾c. Needle antimony nominally 8c. for lump and 10c. for powdered. White oxide, 16½c.

Bismuth—Per lb., New York, in ton lots, $1.85@$2.10. London, 8s.

Cadmium—Per lb., New York, 60c.

Iridium—Per oz., $107@$110 for 98 @99 per cent sponge and powder.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade) for single lots of spot metal.

Palladium—Per oz., $52@$54. Small lots bring up to $58. Pure metal as a constituent of crude platinum, nominal.

Platinum—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Market dull and narrow. For cash transactions in large lots dealers ask $65 and offer $64. Odd lots sold as low as $63. We quote nominally $63@$65. Pure metal as a constituent of crude platinum, nominal at $61. Very dull. London, per oz., £13½@£13¾.

Quicksilver—Range for week, $120@ $118, nominal, per 76-lb. flask. Market shows little life. San Francisco wires $121.67. London, £20¾@£22.

The prices of **Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tellurium, Thallium, Tungsten, and Zirconium** are unchanged from the issue of July 9.

Lead Higher—Zinc Unchanged

Joplin, Mo., July 23, 1927

Blende	Per Ton
High	$44.40
Blende basis, premium, 60 per cent zinc	$44.00@45.00
Blende, Prime Western, 60 per cent zinc	43.00@44.00
Blende, fines and slimes, 60	
Lead, basis 80 per cent lead	$80.00
Average settling price, all zinc	39.81
Galena	
High	79.90
Basis 80 per cent lead	80.00
Average settling price, all lead	79.27

Shipments for the week: Blende, 11,772; lead, 819 tons. Value, all ores the week, $533,600.

Sellers expected an advance in offerings on zinc concentrate, on account of the increase in the price of metal, and were slow to sell on offerings unchanged from last week; but buyers report obtaining sufficient tonnage to cover orders. It is currently reported that the Falcon Zinc Co. has withdrawn from this market and ordered its offices closed. Rumor is to the effect that there is no intention of closing the smelter at Fort Smith, but that slab zinc production will be continued from Western ores. The purchase today was 13,650 tons.

Offerings on lead were advanced $5 per ton, on the strength of the slight increase in pig-lead prices, but producers would not accept this offer for any of the reserve ore.

Platteville, Wis., July 23, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$45.25
Lead Ore	
Lead, basis 80 per cent lead	$80.00

Shipments for the week: Blende, 1,117 tons; lead, none. Shipments for the year: Blende, 37,278; lead, 970 tons. Shipments for the week to separating plants, 1,882 tons blende.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c., Caucasian, washed, 53@55 per cent, 40c. Chemical grades unchanged from quotations in the July 9 issue.

Tungsten Ore — Per unit of WO₃, N. Y.; Wolframite, $10.25@$10.50. Western scheelite, $10.75@$11. Market dull and prices largely nominal.

Chrome, Iron, Molybdenum, Tantalum, Titanium, Uranium, and Vanadium Ores are unchanged from quotations in the July 9 issue.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz, Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the July 9 issue.

Mineral Products

Arsenious Oxide (White Arsenic)—4c. per lb. Business dull. London, Cornish white, per long ton, £15½.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate and Zinc Oxide are unchanged from prices in the July 9 issue.

Ferro-Alloys

Ferrochrome—Per lb. of contained chromium, 60@70 per cent chromium, 4@6 per cent carbon, 11½c.

Ferromanganese—Domestic and foreign, 78@82 per cent, $90 per long ton, furnace or duty paid. Consumers well covered for early needs. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

Ferrotungsten—96@98c. per lb. of W contained, f.o.b. works. Dull.

Ferrocerium, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferro-uranium and Ferrovanadium are unchanged from prices in the July 9 issue.

Metal Products

Rolled Copper—Sheets, 21¾c.; wire, 14¾@15c. f.o.b. mill.

Lead Sheets—Full rolled, 9¾c. per lb.; clipped, 10c.

Nickel Silver—28½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal—Dimension sheets, 19c. per lb.; rods, 16c.

Zinc Sheets—9¾c. per lb., f.o.b. mill.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the July 9 issue.

Steel Quiet But Steady—Pig Iron and Coke Dull

Pittsburgh, July 26, 1927

Conditions in the steel trade have changed little since the first of the month. There is an almost complete absence of the upward swing in buying and production which is expected at this time of year. The expectation rests upon precedent rather than accurate knowledge that steel consumption is really seasonal.

Finished-steel prices continue steady all along the line, the strenuous competition being in service, in quality, and delivery.

Pig Iron—The market continues dull in all districts, with prices steady. Bessemer, $18.50; basic, $17.50; foundry, $18, f.o.b. Valley furnaces.

Connellsville Coke — Production is now light and the spot market stays dull. Furnace, $3; foundry, $4@$4.75.

Mining Stocks—Week Ended July 23, 1927

Stock	Exch.	High	Low	Last		Last	Div.
COPPER							
Anaconda	New York	45⅞	44⅛	45⅞	Jy.16, Au.22	Q	0.75
Arcadian Consol.	Boston	*25	*20	*25			
Ariz. Com'l	Boston	6¼	5⅛	6⅛	Jy. 18, Jy. 30		0.25
Calaveras	N. Y. Curb	...	...	1⅛			
Calumet & Arizona	New York	71	65⅝	70½	Ju. 13, Ju. 20	Q	1.50
Calumet & Hecla	Boston	15⅝	15	15⅝	My.31, Jn.15	Q	0.50
Cerro de Pasco	New York	62⅛	59	61	Jy.14, Au.1	Q	1.00
Chile Copper	New York	36⅛	34⅛	35⅛	Jn.3, Jn.30,	Q	0.62½
Con. Coppermines	N. Y. Curb	2⅜	2⅛	2⅜			
Copper Range	Boston	15	12⅛	15	Ap.2, My.2,	A	1.00
Crystal Copper	BostonCurb	*48	*40	*44			
East Butte	Boston	1⅞	1⅛	1⅞	Dec., 1919		0.50
Granby Consol.	New York	39⅜	38	39	Jn.15 Jy. 1	Q	1.00
Greene-Cananea	New York	51	47⅛	51	Nov., 1920		0.50
Howe Sound	New York	38⅛	37	38	Apr.1,Apr.15	Q	1.00
Inspiration Consol.	New York	17⅞	15⅛	17⅛	Ma.17, Ap.4,	Q	0.25
Iron Cap	Boston Curb	...	...	1⅛			
Isle Royale	Boston	11⅛	10	11	Fe.4, Fe.19,	Q	0.50
Kennecott	New York	66⅛	63⅛	65⅛	Ju. 3, Jy. 1	Q	1.25
Magma Copper	New York	35⅛	34⅛	35⅛	Jn.30, Jy.15,	Q	0.75
Mason Valley	N. Y. Curb	99	76	90			
Miami Copper	New York	15	13⅞	15	Au.1, Au.15	Q	0.37½
Mohawk	Boston	42	40¼	42	Jy.30, Se.1	Q	1.00
Mother Lode Coal	New York	3	2½	3	Jn.10, Jn.30		0.25
Nevada Consol.	New York	14⅛	13⅜	14⅜	Jn. 3, Jn. 7	Q	0.37½
New Cornelia	Boston	22	21	21⅛	Au.5, Au.22	Q	0.50
Noranda	N. Y. Curb	22⅞	22⅞	22⅞			
North Butte	Boston	1½	*90	1½	Oct., 1918		0.25
Ohio Copper	N. Y. Curb	1⅛	*84	1 1/16	Sept. 1926		0.03
Old Dominion	Boston	13⅛	12	13⅛	Dec., 1918		1.00
Phelps Dodge	N. Y. Curb	...	...	110	Jn.18, Jy.1	Q	1.50
Quincy	Boston	15	14	15	March, 1920		1.00
Ray Consolidated	New York	14⅞	14⅞	14⅞	Ap.20, Ap. 30		0.25
St. Mary's Min. Ld.	Boston	21⅛	20⅛	20⅛	Fe.10, Ma.10		2.00
Seneca Copper	New York	1⅛	1⅛	1⅛			
Shattuck-Denn	Boston Curb	5	4⅛	4⅛			
Tenn. C. & C.	New York	9	8⅛	9	My.31,Ju.15,	Q	0.12½
United Verde Ex.	N. Y. Curb	24	24	24	Jy.6, Au.1	Q	0.75
Utah Copper	New York	...	...	115	Jn. 17, Jn. 30	Q	1.50
Utah Metal & T.	Boston	1⅛	1	1	Dec., 1917		0.30
Walker Mining	Salt Lake	*62	*55	*57			
NICKEL-COPPER							
Internat. Nickel	New York	62⅛	60⅜	61⅛	Jn. 16, Jn. 30	Q	0.50
Internat. Nickel pfd.	New York	...	...	109	Ap. 14, My. 2	Q	1.50
LEAD							
Gladstone Mtn	Spokane	*14	*11	*14	April, 1927		0.005
National Lead	New York	115¼	108	112½	Jn.10,Jn.30	Q	1.25
National Lead pfd.	New York	132	132	132	My.10,Jn.15	Q	1.75
St. Joseph Lead	New York	41⅛	37⅛	40⅛	Se.10,Se.20,	QX	0.75
ZINC							
Am. Z. L. & S.	New York	8⅛	6¼	8⅛	May, 1917		1.00
Am. Z. L. & S. pfd.	New York	42⅛	39⅛	40⅛	Nov., 1920		1.50
Butte C. & Z.	New York	4⅛	4⅛	4⅛	De. 9, De. 24		0.50
Butte & Superior	New York	9⅛	8	9⅛	Jn. 17, Jn. 30	Q	0.50
Callahan Zn-Ld.	New York	1⅛	1⅛	1⅛	Dec., 1920		0.50
Consol.Lead&Zinc'A'	St. Louis	...	...	12	Ma.15, Ap.1	Q	0.25
Eagle-Picher	Cincinnati	27	26⅛	27	Au.15, Se.1	Q	0.40
Eagle-Picher pfd.	Cincinnati	116	116	116	Jn.30, Oc.15	Q	1.50
New Jersey Zn.	N. Y. Curb	185	179¼	184¼	Jn.20, Jy.9	QX	2.00
United Zinc	N. Y. Curb	...	...	*55			
Yellow Pine	Los Angeles	...	...	*25	Dec. 1925	Q	0.04
GOLD							
Alaska Juneau	New York	1	1	1			
Argonaut	Toronto	*37	*29	*30½			
Barry-Hollinger	Toronto	*32½	*30½	*31⅝			
Consol W. Dome L.	Toronto	6	5	5⅛			
Cresson Consol. G.	N. Y. Curb	2 3/16	2 1/16	2 1/16	Ma.31,Ap.10	Q	0.10
Dome Mines	New York	7⅛	7⅛	7⅛	Jn.30, Jy. 20	Q	0.25
Golden Cycle	Colo.Springs	†1.73	†1.70	...	My.31, Jn.10	Q	0.04
Hollinger Consol.	Toronto	18.50	18.00	18.40	Jn. 27, Au. 12	Q	0.10
Homestake Mining	New York	61⅛	60⅜	60⅜	Jy. 20, Jy. 25	M	0.50
Kirkland Lake	Toronto	1.39	1.35	1.38			
Lake Shore	Toronto	20.20	19.95	20.20	Jn.1, Jn.1	X	0.20
McIntyre-Porcupine	New York	26	25⅜	26	Au.1, Se.1	Q	0.25
Portland	Colo.Springs	†*35	†*28⅛	...	Ap.6, Ap.15,	Q	0.02
Rand Mines	New York	...	...	9⅛	Au.23-30	Am.Sh.	1.52
Teck-Hughes	Toronto	8.45	8.25	8.29	Jy.21, Au.1		0.10
Tom Reed	Los Angeles			*45	Dec., 1926		0.02
Tough-Oakes	Toronto	*3⅛	*27⅛	*30⅛			
United Eastern	N. Y. Curb	*46	*42	*46	July, 1924		0.05
Vipond Cons.	Toronto	*87	*78	*84⅛	Apr.1, Apr.15		0.03
Wright-Hargreaves	Toronto	6.09	5.75	6.03	Jy.15, Au.1		0.05
GOLD AND SILVER							
Carnegie Metals	Pittsburgh	14⅛	11⅛	14			
Con. Cortez	N. Y. Curb	19	19	19			
Con. Virginia	San Francisco	*3⅛	*3⅛	*3⅛			
Dolores Esperanza	N. Y. Curb	...	...	*50	July, 1923		0.05
Premier Gold	N. Y. Curb	2 1/16	2 1/16	2 1/16	Jn. 14, Jy. 5		0.08
Tonopah Belmont	N. Y. Curb	1⅛	1 1/16	1 1/16	Ma.15, Ap.4		0.08
Tonopah Extension	N. Y. Curb	50	47	47	Apr. 1925		0.05
Tonopah Mining	N. Y. Curb	...	...	2 1/16	Ma.31, Apr.21		0.07½
West End Consol.	N. Y. Curb	...	...	*7	Mar., 1923		0.05
Yukon Gold	N. Y. Curb	...	...	*45	June, 1918		0.02
SILVER							
Beaver Consol.	Toronto	1.10	1.04	1.05	May, 1920		0.03
Castle-Trethewey	Toronto	*82	*78	*78½			
Coniagas	Toronto	4.25	3.55	4.25	May, 1924		0.12½
Keeley	Toronto	1.01	*97	*99	Fe.28, Ma.15	X	0.12
Lorrain Trout Lake	Toronto	...	...	*73	July, 1925		0.05
McKinley-Dar.-Sav.	Toronto	*15⅛	*14	*15	Oct., 1920		0.03
Mining Corp. Can.	Toronto.	3.17	3.05	3.10	Jn. 29, Jy.15		0.12½
Nipissing	N. Y. Curb	5⅛	5⅛	5⅛	Jn.30, Jy.20		0.07½

Stock	Exch.	High	Low	Last		Last	Div.
SILVER-LEAD							
Ahumada	New York	4	3	4	Ma. 25,Ap.4,	QX	0.12½
Bingham Mines	Boston	44	43	44	Jn.27, Jy. 5	Q	1.00
BunkerHill&Sullivan	N. Y. Curb	98⅛	43⅜	48⅜	My.31, Jn.4	X	0.75
Cardiff M. & M.	Salt Lake	*46	*46	*46	Feb. 5, 1927		0.10
Chief Consol.	Salt Lake	2.70	2.70	2.70	Nov., 1926	Q	0.10
Consti'n Mng.&Mill'g	Spokane	*30	*25	*30			
Erupcion	Boston Curb	*65	*45	*60	Jn. 25, Jy. 5	Q	0.07½
Eureka Lily	Salt Lake	1.45	1.42½	1.45			
Federal M. & S.	New York	1.48	1.48	1.48	Jn.25, Jn.29	Spec.	$10
Federal M. & S pfd.	New York	94⅜	94⅜	94⅜	My.25, Ju.15	Q	1.75
Hecla Mining	N. Y. Curb	14⅜	11⅜	14⅜	My.4, Ju. 15	Q	0.25
Highland-Surprise	Spokane	*12⅜	*11⅛	*12			
Iron King Mining	Salt Lake	*50	*50	*50			
Keystone Mining	Salt Lake	...	...	*20	Au. 12, Au. 26		0.07½
Lucky Jim	Spokane	*18⅛	*17⅜	*17⅛			
Lucky Tiger-Com.	Kansas City	†7.05	†6.85	...	Jy.10, Jy.20		0.05
Mammoth Mining	Salt Lake	1.65	1.50	1.50	Jn.10, Jn.20	Q	0.05
Marsh Mines	Spokane	1	1	1			
North Lily	Salt Lake	3.55	3.45	3.55			
Park Utah	New York	6⅞	6⅛	6⅜	Jn. 25, Jy. 1	Q	0.20
Plutus Mining	Salt Lake	1.50	1.50	1.50	Jy. 10, Jy. 15	Q	0.10
San Rafael	San Francisco	...	...	*24			
Silver King Coal	Salt Lake	8.20	7.80	8.20	Jn. 20, Jy. 1	Q	0.25
Silversmith	Spokane	*31⅛	*28⅛	*31⅛	Oct., 1926	Q	0.02
Strattons Mines	Spokane	*51	*50	*51			
Sunshine M. Co.	Spokane	1.08	*98	1.05			
Tamarack-Custer	Spokane	*27⅛	*25⅛	*27	Sept., 1924		0.25
Tintic Standard	Salt Lake	12.12½	12.00	12.12½	Jn.15, Jn.28		0.40
Utah-Apex	Boston	5	4⅛	5	Oct., 1926		0.25
IRON							
Bethlehem Steel	New York	51⅛	49¾	50⅛	July, 1924		1.25
Cleveland-Cliffs Iron	Cleveland	11⅝	86½	101	Jy. 15, Jy. 25	Q	1.00
Colorado Fuel & Iron	New York	94⅛	84⅜	86⅜	May, 1921		0.75
Gt. North'n Iron Ore	New York	92½	91¼	92	Dec. 6, Dec. 28		0.75
Inland Steel	New York	53¾	50	53	My. 13, Jn. 1	Q	0.62½
Replogle Steel	New York	...	...	12⅛			
Republic I. & S.	New York	66¼	65	66	Au. 15, Se. 1	Q	1.00
Republic I. & S. pfd.	New York	...	...	103½	Se. 15, Oc. 1	Q	1.75
Sloss-Sheffield S. & I.	New York	125	123	125	Jn. 10, Ju. 20	Q	1.50
Sloss-Shef. S.&I. pfd.	New York	...	...	107	Jn. 20, Jy. 1	Q	1.75
U. S. Steel	New York	126⅛	1.24¼	125⅜	Jn. 7, Jn. 29	Q	1.75
U. S. Steel, pfd.	New York	133⅞	133⅛	133⅜	My.2, My.28	Q	1.75
Virginia I. C. & C.	New York	....	....	43	Jan., 1924		1.50
Virginia I.C.&C. pfd.	New York	....	....	60⅛	Ju. 15, Jy. 1		2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN							
De Beers Consol.	New York	...	...	27⅛	Jn. 26, Jn.30		1.45
So. Am. G. & P. New	N. Y. Curb	2⅜	2⅛	2⅛			
Alum. Co. of Amer.	N. Y. Curb	99	84	97			
Alum. Co. of Amer.pf.	N. Y. Curb	102⅛	102¼	102¼	Jn. 15, Jy. 1	Q	1.50
Vanadium Corp.	New York	50⅛	47⅛	49	Au. 1, Au. 15	Q	0.75
Patino M. & E.	New York	23	22	22⅜	Ap. 27, My. 5		1 sh.
ASBESTOS							
Asbestos Corp.	Montreal	24	23	23⅜	Jan., 1926		1.50
Asbestos Corp. pfd.	Montreal	88	87	87⅛	Jn.30, Jy.15	Q	1.75
SULPHUR							
Freeport, Texas	New York	76⅛	67⅜	75⅜	Jy. 15, Au.1	QX	1.25
Texas Gulf	New York	67⅛	65⅛	65¼	Ju. 1, Ju. 15	Q	1.00
MINING, SMELTING, REFINING AND GENERAL							
Amer. Metal	New York	40⅞	39⅛	39⅞	Au.20, Se.1	Q	0.75
Amer. Metal, pfd.	New York	...	...	108	Au.22, Se.1	Q	1.75
Amer. Sm. & Ref.	New York	161⅜	157⅓	160¼	Jn.8, Au. 1	Q	2.00
Amer. Sm. & Ref. pfd.	New York	128	127⅛	128	Au. 1, Se. 1	Q	1.75
Consol. M. & S.	Montreal	232	226	228	Jn. 30, Jy. 15	X	6.25
Newmont Mining	N. Y. Curb	87⅜	78⅛	87⅛	Jn.30, Jy.15	Q	1.00
U. S. Sm. R. & M.	New York	36⅜	34⅜	36⅛	Jy. 6, Jy. 15	Q	0.87½
U.S. Sm. R.&M. pfd.	New York	48⅛	48⅛	48⅛	Jy. 6, Jy. 15	Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

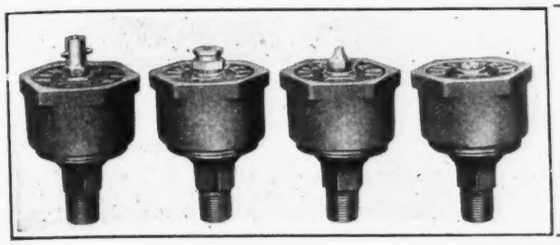
Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Inve.tment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED JULY 12, 1927

Name	High	Low	Last	Date	Last Div. Amount
Aramayo Mines (25 frs.)	80/—	76/3	78/9	Aug., 1927	5 p.c. (†)
British Platinum (£1)	3/—	2/—	3/—	Feb., 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/—	13/6	13/9	Aug., 1927	6 annas*
Bwana M'Kubwa (5s)	5/7½	5/—	5/6		
Camp Bird (2s)	4/—	3/6	4/—		
El Oro (£1)	3/10½	3/6	3/10½	Nov., 1924	2½ p.c.*
Esperanza (10s)	—/2½	—/2½	—/2½		
Frontino & Bolivia (£1)	15/—	11/3	11/3	July, 1927	5 p.c.
Mexican Corpn. (£1)	10/3	8/9	9/9		
Mexico Mines of El Oro (£1)	16/3	15/—	15/—	Dec., 1926	3¾ p.c.*
N'Changa Copper Mining	12/9	12/6	12/9		
Oroville Dredging (£1)	5/3	4/9	5/—	Dec., 1923	3¾ p.c.
Ouro Preto (£1)	2/1½	2/—	2/—	May, 1925	2½ p.c.
Rhodesian Congo Border (£1)	57/6	52/9	55/—		
St. John del Rey (£1)	11/6	11/3	11/6	May, 1927	3¾ p.c.
San Francisco Mines (10s)	29/6	27/3	29/3	July, 1927	15s.
Santa Gertrudis (£1)	18/10½	17/9	18/10½	July, 1927	7½ p.c.
Selukwe (2s. 6d.)	8/—	7/3	7/6	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/1½	2/11½	3/—	Nov., 1917	75 p.c.
Tanganyika (£1)	57/6	47/6	48/3	Aug., 1926	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	9.240	9.150	9.240	July, 1927	182.60 (‡)

* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.

New Machinery and Inventions



A New Grease Cup

Fitted with means of pressure lubrication, this hexagonal top offers many advantages.

These Novel Grease Cups Made With Pressure Fittings

Of interest to all manufacturers whose processes or products require the use of grease cups, should be the announcement of Link-Belt Co. of Chicago, Indianapolis, and Philadelphia, which describes their new "Hex-Top" malleable-iron compression grease cup equipped with Alemite, or Zerk, fittings.

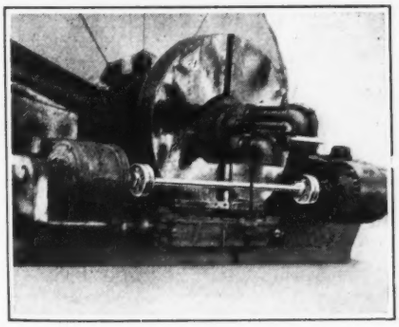
The name "Hex-Top" aptly describes the shape of the grease cup head. Being six-sided, it offers an easy purchase for turning by any type of wrench and a good grip for the hand. The combination of compression grease cup and Alemite fitting is claimed to be a distinct improvement over either article used separately.

One application of these attachments is to the lubricating system of a long belt conveyor using many grease cups on the idlers. Here the easiest, quickest and most economical way to fill all the cups is said to be with a grease gun applied to the Alemite fittings. The cap of the cup is, of course, turned up but not entirely unscrewed or removed.

The filling can be done without waste of grease or any inconvenience. The cup holds a supply of grease for use by compression. An occasional slight screwing down by hand or with a wrench is all that is necessary for proper lubrication until a general refilling of the cups is required. If a bearing heats up when the grease gun is not at hand, a turn or two of the cap takes care of the emergency. It would appear that there is a wide variety of uses for this cup in industry. It is now available.

Unsupported Shafts Driven by Flexible Couplings

Although popular opinion has long held to the belief that an unsupported shaft could not be successfully driven through flexible couplings, the manufacturers of a well-known line of



Unsupported shaft on continuous filter

continuous automatic filters have successfully applied such couplings, manufactured by the Ajax Flexible Coupling Co., Westfield, N. Y., to filter operation.

The illustration shows an unsupported shaft on the drive end of a continuous filter used for dehydrating cement slurry. The motor, mounted on the right side of the filter, drives a shaft 4 ft. long through an Ajax coupling. This shaft is fixed to another similar coupling on the left side which connects with a speed reducer.

The successful driving of this unsupported shaft is attributable to the precision-made parts of the coupling. Rubber bumpers, ground to size, perform the double duty of effecting complete insulation and absorbing shocks. The bumpers are firmly cemented around bronze bushings and into the holes in the flanges. They are thus protected from dirt, oil and water.

Hardened, high-carbon steel pins or drive-studs are the connecting media. They are ground to limits of 0.001 in. to assure absolute alignment, eliminate friction and prevent binding and vibration. Oilless bronze bushings, impregnated with graphite for self-lubrication, and fitted into the bumpers, furnish a bearing for the steel pins.

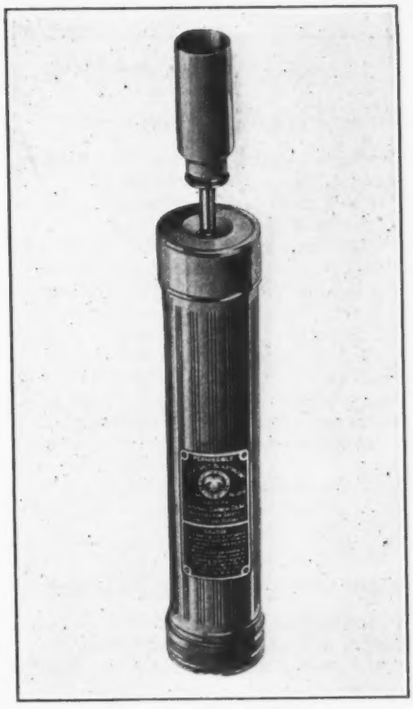
These couplings are made by means of jigs and master dies so as to insure accuracy and interchangeability of parts. The engineers who designed and installed the drive shown believe its success is due to the unusual precision with which the couplings are made.

Electric Shot-Firing Unit Safe and Convenient

What is said to be the most convenient and the safest battery-powered shot-firing device ever offered has recently been announced by the National Carbon Co., Inc., of New York. This machine, known as the Eveready Shot-Firing Unit, has been approved by the U. S. Bureau of Mines. Its unique features also make it suitable for use on the surface, in quarries, in stump blasting and, in fact, wherever blasts are fired one at a time.

It is small, compact and light in weight and, as no fuses are required, dangers from misfires and delayed shots are eliminated. This device, operating on dry batteries which are easily renewed, is said to be absolutely safe, as the shots cannot be fired accidentally. The wires leading from the cap are fastened to a special plug and, in order to fire a shot, it is necessary to insert this plug in a small socket in the end of the device and to hold it there against the pressure of a spring. The plug cannot be left in contact, as the spring forces it out of connection as soon as it is released by the hand.

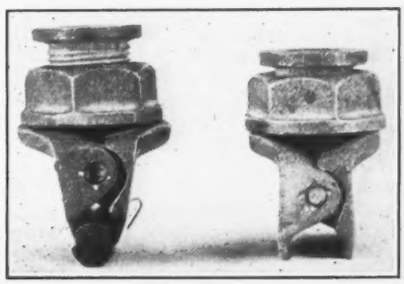
The device is equipped with a convenient ring hanger on the bottom cap for hanging on the belt or on a nail or hook on the wall.



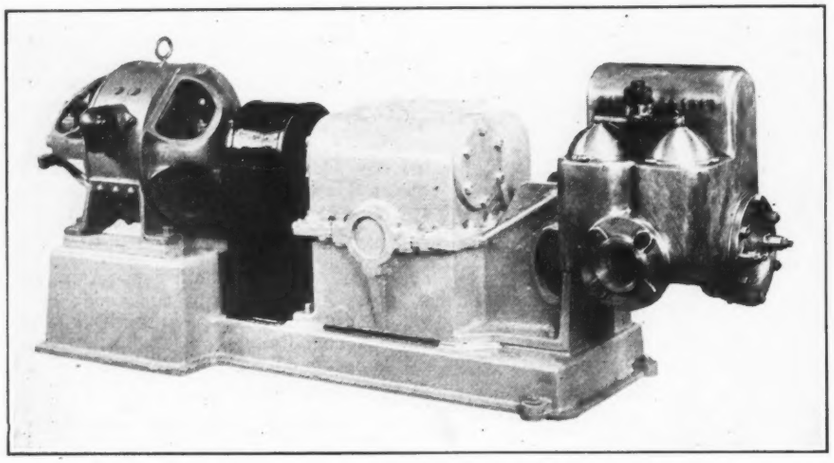
"Single Shooter" of unique design

Clamp Exerts Tremendous Holding Power

The Archi heavy-duty mine clamp combines great holding power and good wheel clearance. By the arrangement of the leverage it is possible to secure a grip on the wire which will resist a 3,800-lb. pull. The thin jaws on the clamp eliminate arcing both on curves and with worn trolley wheels. A flexible self-opening feature minimizes the difficulty in stringing wire on curves. This clamp is made by the Westinghouse Electric & Manufacturing Co.



Heavy-duty mine trolley clamp



Compactness and safety are combined in this new pump

Pump with Worm-Gear Drive

The new worm-gear driven Austin gathering pump shown in the illustration has an inclosed oil-tight drive unit between the motor and the pump cylinder. The reduction in speed required on these pumps is from approximately twenty to one for 1,100 revolutions per minute motors to thirty to one for 1,750 revolutions per minute motors. This reduction is effected by means of a worm gear using a heat-treated ground worm mounted upon ball bearings. Transformation from the rotating motion of the worm wheel to the reciprocating motion of the piston rod is effected by means of a Scotch yoke, which is guided top and bottom by long shoes. All materials used in this mechanism are bronze, cast steel, and forged steel.

One of the main advantages of this drive unit is the elimination of all spur gearing and the elimination of exposed moving parts. Furthermore, the operation in oil means practically continuous life without attention. The oil will have to be replenished about once a year.

Another feature of this pump is its width. The extreme over-all width is only 25 in. This allows for installation in many cases without much, if any, expense for making sufficient room.

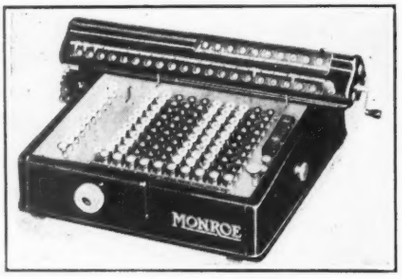
The manufacturer of the complete unit is the Dravo-Doyle Co., Pittsburgh, Pa.

Makes " Figgerin' " a Pleasure

Arithmetic began with the counting of fingers and toes. The abacus, known to the Babylonians as early as 2200 B.C., was the immediate successor of men's fingers in the field of mechanical counting. Different types of this instrument were developed and, in various forms, it is still used in China, Russia and Japan.

For centuries afterward there was no significant change in the methods of calculation, but about 1200 A.D. the present system of numerical notation was introduced into Europe. Soon afterwards, the development of mechanical calculation began and in 1642 Blaise A. Pascal, a young Frenchman, constructed the first model of an arithmetical machine that provided for the carrying of tens. Following him were Leibnitz and his contemporary, Thomas of Colmar, France. To the latter belongs the credit of having produced the first durable calculating machine suited for practical use. Mr. Thomas' first model was produced in 1820.

However, it was more than 50 years later that Frank S. Baldwin, an American, produced the first directly reversible type of adding-calculator where addition and multiplication were performed with easy, simple, forward turns of a crank; and subtraction and division with equally simple, backward turns of the crank without, in either case, necessitating the manipulation of a change lever. Recognition of the



An automatic calculator

value of calculating machines was slow, and in 1892 there were only 500 machines in use throughout the world.

In 1911 the Monroe Calculating Machine Co., of Orange, N. J., assumed control of Mr. Baldwin's device. The result is the "Monroe Adding-Calculator," which has developed in sixteen years from a rather crude beginning to the present "full automatic" machine. This new electrically-operated model is called a full automatic because all that is necessary, for example, to divide two numbers is simply to set one number in the lower dials and the other on the keyboard and push the division control key. The machine then automatically carries through the complete division. Not only is the calculation made as rapidly as the answer can be conveniently copied, but the answer is infallibly accurate. A similarly simple procedure is followed for multiplying.

Catalogs

Babbitt — A small illustrated pamphlet entitled "Babbitt Metal Data" discusses the selection of babbitt metal and gives points to be considered in the use of babbitt for bearings, with instructions for casting the babbitt and fitting the bearings. A description of the grades of babbitts made by this company is also included.—Hoyt Metal Co., St. Louis, Mo.

Circuit Breakers—A 12-page circular, No. 1771, illustrates the construction, operation and application of the Types D-16, D-20 and D-26 circuit breakers.—The Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Commutator Repair Equipment — Catalog No. 7 describes the commutator slotting and grinding equipment and other motor repair accessories manufactured by this company.—Martindale Electric Co., P. O. Box 2660, Cleveland, Ohio.

Dust Filter—Bulletin 181 shows with photographs and drawings the design and construction of the Whiting dust filter.—Whiting Corp., Harvey, Ill.

Flooring—A new bulletin describing Mitco interlocked steel floor grating has been published by the Hendrick Manufacturing Co., 60 Dundaff St., Carbondale, Pa.

Gas-Welding Apparatus — Catalog 172-E describes and illustrates various types of welding and cutting apparatus. —The Alexander Milburn Co., 1416-1428 West Baltimore St., Baltimore, Md.

Lift Trucks—The new model H Revolvator Liftrucks are described and illustrated in Bulletin 90-J. A table giving the dimensions of the various sizes of trucks is included.—Revolvator Co., 336-352 Garfield Ave., Jersey City, N. J.

Mechanical Brake — Bulletin 102-A describes the Clark type Three C brake for mechanical operation, such as in connection with the bridge drive of electric cranes.—The Clark Controller Co., Cleveland, Ohio.

Nickel Steel—Data and applications of nickel steel are given in bulletin No. 10, entitled "Chrome-Nickel Steel in Special Trackwork," published by the International Nickel Co., 67 Wall St., New York.

Oil and Grease Equipment—A collection of bulletins illustrates and describes the Bennett oil and grease storage and handling equipment.—Bennett Pump Corp., Muskegon, Mich.

Preheating Torch — A circular describes Smith's preheating torches for use in connection with welding, for heating and bending metal, expanding parts, melting babbitt, drying molds, and crucibles, and similar work.—Smith Welding Equipment Corp., Minneapolis, Minn.

Roller-Bearing Trolleys—A folder describes the Morris roller-bearing trolleys with illustrations of the construction and application and contains a list of sizes and capacities.—Herbert Morris, Inc., Buffalo, N. Y.